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Relationship between Residency Training and

Practice Location in Primary Care

Residency Programs in Texas

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Relationship between Residency

Training and Practice Location in

Primary Care Residency Programs in Texas

by

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This dissertation is dedicated to the love of my life Andy and

to our wonderful daughter Sloane.

I am truly blessed to be on this journey of life with you both.

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Relationship Between Residency

Training And Practice Location In

Primary Care Residency Programs In Texas

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This dissertation analyzes one state's efforts to increase the number of its primary care physicians and encourage their retention and distribution to rural underserved areas. This analysis was accomplished through an examination of physicians as they completed training in Texas family medicine, internal medicine, pediatrics, and obstetric/gynecology residency programs. State licensure data provided insights into these primary care specialties by showing which residents remained in the state to practice, and by showing the numbers and specialties of physicians who practice in rural underserved areas.

The primary purpose of this study was to increase understanding and document similarities and differences in the primary care residency programs' production of physicians who remained in Texas and who practiced in a whole county HPSA following training. The following analyses were used to evaluate the research questions and hypotheses: frequency distributions, geographic depictions, Chi-Square tests and binary logistic regression. These analyses provided supporting evidence that significant differences exist among resident programs in the four primary care medical specialties. Differences were also found in residents' likelihood to remain in Texas to practice and their likelihood to practice in whole county Health Professional Shortage Areas (HPSAs).

This study showed that those residents who trained in Texas largely remained in Texas and actively practiced medicine years after their residency training had been completed. The training and location of primary care physicians in Texas is influenced by what medical specialty programs are available and where. This suggests that increasing the number and type of residency programs in more remote areas may have a positive influence on the physician workforce of those regions.

This study confirms the finding of other institutional and single medical specialty studies that physicians tend to remain in the state in which they complete their residency training. However, this study found that there are variations by primary care specialty, gender, ethnicity, and program location. Residency training is an essential piece in supplying the Texas physician workforce and ensuring that its stability and long-term growth will position it to be prepared to care for the population.

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CHAPTER 1

Introduction

This dissertation analyzes one state's efforts to increase the number of its primary care physicians and encourage their retention and distribution to rural underserved areas. This analysis was accomplished through an examination of physicians as they completed training in Texas family medicine, internal medicine, pediatrics, and obstetrics/gynecology residency programs. State licensure data provided insights into these primary care specialties by showing which residents remained in the state to practice, and by showing the numbers and specialties of physicians who practice in rural underserved areas.

Background

Primary Care Physicians

Primary care physicians are educated and trained to treat and provide health care focused on the whole person, to rely on the development of a relationship with a patient that may span a lifetime, and to serve as a patient's initial point of entry in the health care delivery system. As such, these elements are often identified as the common characteristics of primary care. Collectively these characteristics led researchers and others to define primary care as the provision of "general" care for any given population. Because of their provision of "general" care for patients, primary care physicians are also called generalist physicians. While the term has been used for several decades, its use increased in the late 1990s with specific reference to four types of primary care physicians -- family physicians, general internists, general pediatricians, and obstetrician/gynecologists -- as distinct from all other disciplines in medicine which were referred to as specialists (Fourth Report, Council on Graduate Medical Education, 1998). The term "generalist" is interchangeable with the term "primary care" and also refers to family practice, internal medicine, pediatrics, and obstetrics/gynecology. In 1994, the Institute of Medicine (IOM) set forth the following definition:

> Primary care is the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community (Institute of Medicine, 1994, p.15).

While this IOM definition does not clearly present the medical specialties of primary care, in a subsequent IOM publication, the medical specialties of family practice, internal medicine, pediatrics and obstetric/gynecology were identified as those most likely to provide primary care (IOM, 1996). These four medical specialties are the focus of this dissertation.

Just what are these four medical specialty areas? The American Academy of Family Physicians sets forth the following definition of family medicine:

> Family medicine is a medical specialty which provides continuing, comprehensive health care for the individual and family. It is a specialty in breadth that integrates the biological, clinical and behavioral sciences. The scope of family medicine encompasses all ages, both sexes, each organ system and

> every disease entity (from American Academy of Family Physicians, accessed on-line at www.aafp.org).

The Accreditation Council on Graduate Medical Education, Residency Requirements defines the specialty of internal medicine as follows:

> Internal medicine is the medical discipline encompassing the study and practice of health promotion, disease prevention, diagnosis, care, and treatment of men and women from adolescence to old age, during health and all stages of illness. Intrinsic to the discipline are scientific knowledge, the scientific method of problem solving, evidence-based decision making, a commitment to lifelong learning, and an attitude of caring that is derived from humanistic and professional values (from ACGME, Internal Medicine's Residency Requirements, accessed on-line at www.acgme.org).

The medical specialty of pediatrics is defined by its professional association, the American Academy of Pediatrics:

> Pediatrics is the medical specialty focused on the physical, emotional, and social health of infants, children, adolescents, and young adults from birth to 21 years. Developmentally oriented and trained in skilled assessment, their patient-care lens is focused on prevention, detection, and management of physical, behavioral, developmental, and social problems that affect children (from Pediatrics 101, AAP.org, accessed on-line at www.aap.org).

The America Board of Obstetrics and Gynecology defines the medical specialty as:

> Obstetricians-Gynecologists are physicians who, by virtue of satisfactory completion of a defined course of graduate medical education and appropriate certification, possess special knowledge, skills and professional capability in the medical and surgical care of the female reproductive system and associated disorders, such that it distinguishes them from other physicians and enables them to serve as consultants to other physicians and as *primary physicians* for women (from ABOG, accessed on-line at www.abog.org).

Though their patient populations vary, the physicians that practice in one of these four areas of medicine share a general approach to the whole patient, rather than focusing on a specific organ or disease. They each serve as the initial point of contact for a majority of their patients, and collectively they provide the bulk of health care services to a state's general patient population. Physicians in all four of the primary care specialties offer patients one-time or sporadic care, or some mixture of the two.

Additionally, primary care physicians may provide a patient with an initial diagnosis and evaluate whether to refer the patient to another type of physician. In this role, which increased with the widespread acceptance of managed health care, a patient is required to obtain a referral from his or her primary care physician to seek the advice or action of another more specialized physician. This role has led to the primary care physician being called the "gatekeeper" of medical care. To some this role has negative implications and is viewed as diluting the broad array of services primary care physicians provide. Patients dislike being forced to see a primary care physician to gain access to specialty care; however, on the positive side this is an opportunity for primary care physicians to serve as true coordinators of care, providing a home base for patients' health care needs.

Because these specialties serve as the primary care physicians in the U.S. health care system, ensuring an adequate supply is an important health policy consideration. To understand how and why the varied roles and responsibilities of the primary care physician are critical to the existing health care system and provide a backdrop in the broader context of U.S. physician workforce, it is important to understand the physician education and training pipeline.

Pipeline for Residency Training

The study of medicine culminating in the doctor of medicine (MD) or doctor of osteopathic medicine (DO) in the United States is expensive, lengthy, and fragmented. Since the 1970s, the education and training of MD and DO physicians has blended so the two are effectively equivalent. Their medical school experiences are similar as they are exposed to and must master the same curricula, and finally, they are required to pass the same licensure exams.

Acceptance into medical school is the beginning of the medical education pipeline. Many states have policies in place to encourage students to remain in their home states to attend medical school. In many ways these policies are similar to policies in place at the undergraduate level. For example, states typically charge in-state students (at the undergraduate and medical school level) lower tuition than their out-of-state counterparts. Generally, in-state students are defined by their parent's state of legal residence or the state in which the students graduated from high school. Further encouraging in-state retention for medical school, many states restrict enrollment to state public medical schools for out-of-state students. In Texas for example, the state sets limits on the number of out-of-state students that may be admitted to medical school (79th Texas Legislature, Regular Session, State of Texas Appropriations Act, Article III-Section 13, Limitation of Nonresident Enrollment in Certain State-supported Professional Schools). Currently, this limit ranges from 10 to 20 percent of a medical school's entering class each year. The limitation is set forth in a rider to the state's appropriations act. The net effect is a limitation on non-Texan admissions to state medical schools by the Texas Legislature.

The rationale for such limits is that the state provides its citizens with the opportunity to attend medical school because it assumes that these students will eventually practice in the state. The belief is that these medical students will eventually provide care for the state's citizenry. Oddly, the final stage of medical education, graduate medical education or residency training, is not governed by similar state restrictions.

A limiting factor in pursing medicine as a career is the cost of medical education. Medical education is expensive. For the 2003 academic year, the average annual total cost for attending a U.S. medical school was $31,858 for public institutions and $48,425 for private institutions (Association of American Medical Colleges, Jolly, Medical Education Costs and Student Debt, accessed on-line at https://services.aamc.org/Publications). The price of a U.S. medical education is on the rise and has been for several years. This has resulted in graduates carrying greater debt loads. AAMC Graduation Questionnaire data show that in 1998, U.S. public medical school graduates owed an average of $70,000 in debt and their private school counterparts owed an average of $99,000 (on-line at AAMC.org). By 2003, graduates of public medical schools owed $90,000 and graduates of private medical schools owed $117,000. In 2003, only 17 percent of medical school graduates reported graduating without any debt and almost five percent reported educational debt levels greater than $200,000 (Jolly, 528). Jolly also looked at racial and ethnic minority groups underrepresented in medicine, including, African American, Latinos, and Native Americans, and found that students in these groups incurred debt at about the same rate as white students.

Unlike many professions, receipt of the terminal medical degree (MD or DO) does not represent the end of the medical education and training pipeline. Rather, residency training, also called graduate medical education, is the next educational and training requirement physicians must complete prior to beginning medical practice. So, educating and training a physician is time intensive, requiring a minimum investment of at least eleven years: four in college, four in medical school, and a three year residency program. This lengthy process means that typically physicians are in their late twenties to early thirties by the time they complete residency training. Length of residency training varies by specialty, ranging from three to seven years. Most states require physicians to complete a minimum of one year of residency training as one requirement for a medical license.

The U.S. system of residency training is organizationally fragmented, with more than 8,000 nationally accredited residency programs located throughout the country. This system of training traces its early beginnings to Johns Hopkins University and Hospital in Baltimore, Maryland. In 1893 Hopkins was the first higher education institution to require faculty to provide hospital-based training for medical students. The term *residency* was coined and referred to the requirement that physicians training in the hospital had to live or reside in the hospital. This model became the standard with the endorsement of Abraham Flexner's seminal report in 1910.

Residency education and training requirements are monitored by specialty representatives through an accreditation process. Revisions and changes are incorporated over time so that advances in the specialty become part of the training. Oversight of specialty requirements is the responsibility of each specialty area and is controlled by a select group of experts. This approach has resulted in residency requirements that vary by medical specialty. Notably, variations are found in requirements for years of training, faculty-to-resident ratios and skills and/or procedures required. Accreditation of residency programs is the purview of two accrediting bodies: the Accreditation Council on Graduate Medical Education (ACGME) for MD (allopathic) programs and the American Osteopathic Association Council on Postdoctoral Training (AOA-CPT) for DO (osteopathic) programs. While the medical specialties are aligned under these two umbrella organizations, internally they are self-regulated, which contributes to fragmentation. Interestingly, DO physicians may complete MD residency training programs; however, only DO degreed physicians may complete DO residency programs.

Continuation in residency training following the completion of all or a portion of one of the primary care specialties is called sub-specialization. This is most common for residents in internal medicine, as more than half of the residents training initially in internal medicine residencies will pursue training in sub-specialty areas of medicine. In internal medicine a physician may begin a residency program and successfully complete one year (or more) of training with the knowledge and desire to enter another more highly specialized residency program for additional training. Some examples of residency specialties that require a year of internal medicine include cardiology, surgery, and dermatology.

Unlike those who enter residency training in internal medicine, the majority of physicians who enter the other three primary care specialties will practice as primary care physicians and do not continue their training to sub-specialize. The other primary care specialties, family medicine, pediatrics, and obstetric/gynecology require completion of the entire primary care residency program prior to adding subsequent training years for sub-specialization. These three primary care residency programs are considered "categorical" residency programs, meaning that the residents enter the program with the understanding that they will complete the entire category of training requirements for that specialty.

Differing significantly from the process to enter a medical school, entry into the majority of residency programs is determined competitively through a nationwide matching process. Students in their fourth year of medical school spend several months visiting and interviewing with potential residency programs. It is not uncommon for medical students to visit as many as twenty residency programs during the summer and fall of their fourth year of medical school (Iserson, 2003). Not yet graduated from medical school, these soon-to-be resident physicians compete for desirable positions in hospitals throughout the country. The process is called "the match." It is run by a national non-profit corporation, the National Residency Matching Program (NRMP), and is sponsored by the following organizations: the American Board of Medical Specialties, the American Medical Association, the Association of American Medical Colleges, the American Hospital Association, and the Council of Medical Specialty Societies.

The match process requires the medical students and other participating physicians to select a medical specialty and prioritize their preferences for residency training location. Residency programs that fill all available positions during the match are generally viewed as more competitive and selective than programs that have unfilled positions following the match. Residents unsuccessful in the match process may obtain positions after the match in residency programs still having vacancies. Often residency programs fill remaining positions with medical graduates from schools outside the U.S. These physicians may be U.S. citizens or visitors from foreign countries; collectively they are called International Medical Graduates (IMGs). Controversy surrounds the residency training of IMGs, with many national policy-makers suggesting that limits be placed on the number of IMGs allowed to train in the U.S. (Ninth Report, Council on Graduate Medical Education, 1997; Pew Health Professions, 1995; Mullen, Politzer, &

Davis, 1995). However, hospitals often offer residency training and rely upon IMGs to help staff their departments.

Resident physicians are contractually obligated to the programs to which they are matched or join following the “scramble” to fill residency positions that remain open after the match. As a result, a large proportion of medical students leave the state where they completed medical school and begin the final segment of their formalized education and training in another state. Importantly, these physicians often remain and practice in the state in which they complete their residency training. Therefore, they do not return to the state from which they received their medical degree, thus “short circuiting” their home state’s intention of training physicians for their populace.

Upon successful completion of each residency year (July 1 through June 30), resident physicians receive renewed annual contracts. These contracts continue for the length of the specialty program as set by accreditation requirements. (For example, family physicians are required to complete three years of residency training, so family practice residents contract to train for three years.) In return the resident receives a “living wage” stipend, which increases as the resident progresses through training. In 2005, the mean national stipend for a first-year resident was just over $42,000 for all specialties (Association of American Medical Colleges, accessed on-line at www.aamc.org/data/housestaff/).

States are responsible for developing, maintaining, and revising physician licensure requirements. While state medical boards communicate with one another in the development of licensure regulations, variations exist. Some states require physicians to complete only one year of residency training, while others require more. Many states place tighter controls on physicians who received their medical degrees from foreign medical schools, requiring these physicians to complete additional years of residency training to qualify for state licensure. However, no state has systematically studied where its physician population was educated and trained, as it relates to where these physicians practice within the state.

Over the years, proposals have been made to limit the number of residency positions in the U.S. In the Fourth Report of the Council on Graduate Medical Education (COGME), released in 1994, the federal commission called for a reduction in the number of residency positions available nationally from 140 percent of the total number of medical school graduates to 110 percent (Council on Graduate Medical Education, Fourth Report, 1994). With the passage of the federal Balanced Budget Act of 1997, caps were placed on the number of residents that a hospital may include in its Medicare cost reports, which generate federal payments. These caps have been maintained and the result is a limitation on the number of residents that a hospital may report to receive Medicare funding to the number of residents in training at the hospital in 1996. However, the number of residency positions continues to increase, indicating that the call for reduction has not been heeded and the Medicare caps are not influencing the total numbers of residents in training.

Nationally, there is an excess of residency positions, relative to the number of U.S. medical school graduates. In 1993, there were an estimated 1.43 resident positions for each MD graduate (Eisenberg, 1994). While the number of U.S. allopathic (MDs) medical graduates remained relatively constant for the next ten years, the total number of first-year resident positions continued to increase. By 2003, there were 1.56 resident positions available for every U.S. MD graduate (National Residency Matching Program, data tables, 2005, accessed on-line at www.nrmp.org). Approximately 30 percent of the excess residency positions are filled by IMGs and the remaining slots are filled by physicians who were either unsuccessful in the match process, or were graduates of osteopathic medical schools (DO). Some positions remain unfilled.

Once physicians complete their residency training, they begin to practice medicine officially. Where physicians choose to locate their practices is an important state workforce issue, and serves as an indicator of access to care for a population or community. Whether or not a state is able to retain its physicians following completion of residency training is not widely understood. The overall belief is that physicians locate their practices in the states in which they complete residency training.

Practice Patterns

The body of literature analyzing physician specialty selection includes several variables which have been correlated with specialty selection and practice patterns including: physician background, spousal background, perception of potential earnings, educational debt, practice opportunity, and geographic location of the practice and the residency program (Council on Graduate Medical Education, Tenth Report, 1998). Individual characteristics thought to influence specialty selection include gender, ethnicity, and the location of the residency program. These characteristics are thought to be predictive of increased likelihood of a physician practicing a specific specialty, such as primary care, and may indicate where a physician is likely to set up practice. However, the literature on practice location presents several conflicting interpretations. Some studies have found that a spouse's role is the most important factor in determining whether a physician pursues a primary care career and locates in a rural community, while other studies suggest that the physician's own background is a better predictor (Jensen & Dewitt, 2002; Blondell, Mason, Looney & James, 1992; Brooks, Walsh, Mardon, Lewis & Clawson, 2002).

Many researchers agree that newly graduated physicians have a high degree of understanding concerning the future earning potential offered by the various medical specialties (Reinhart, 1989; Eisenberg, 1994). Most researchers recognize that future earning potential strongly influences whether or not physicians elect to practice one of the primary care specialties or select one of the more lucrative medical specialties (surgical or procedure specialties, such as orthopedic surgery, cardiology, dermatology) (Kiker & Zeh, 1998; Rosenthal, et al., 1994). While consideration of future earnings is influential in medical specialty selection, existing debt load may also play a role. One study found that physicians with higher medical education debt showed a tendency to enter primary care specialties in greater numbers when federal or state loan forgiveness programs were available (Colquitt, et al, 1996). Available practice opportunities and their geographic locations also play a role in physician practice patterns (Donner, Burr & Tucker, 1999; Kahn, 1996).

During the period covered by this study, many believed the role of primary care physicians would continue to grow in importance to the U.S. health care system. This was especially true for the family physician. However, patient demand for access to specialty health care limited primary care growth. The number of residency positions available in family practice declined, reaching an all time low in 2005, with just 3,182 first year residency positions available nationally. In contrast, the overall number of residency positions available continued to increase.

The financing of residency programs may play a role in this decline and in the development of medical specialists. Residency program financing is complex with multiple federal, state, and local funding streams combining to support day-to-day operations. Federal Medicare dollars provide funds to hospitals that have residency programs through add-on payments called Direct Medical Education (DME) and Indirect Medical Education (IME) payments. In 2000, these payments provided an estimated $6.9 billion to the nation's teaching hospitals. By 2004, the Congressional Budget Office estimated this amount to be $9 billion (CRS Report for Congress, February 2005). This means that American taxpayers contributed an estimated $90,000 annually for the training of every resident physician in 2004.

Medicare DME payments are linked to the costs of resident stipends and faculty salaries and are provided for the operational costs of residency programs, including administrative costs. These payments were estimated at $1.9 billion for both FY 2003 and FY 2004. IME payments were started in 1984. They cover additional hospital costs associated with operating residency programs, including increased testing and use of technologies by residents as they learn to diagnose disease and continue learning. They were estimated at $6.9 billion in FY 2003 and $7.1 billion in FY 2004.

Some hospitals that do not have large Medicare patient complements, such as children's hospitals and cancer centers, also receive federal Medicare dollars. The payment methodology for these hospitals is not linked to residency training. Because pediatric residency training occurs primarily in children's hospitals, it is notable that federal Medicare support differs among the various primary care residency programs.

It is important to recognize that federal dollars are provided to the nation's teaching hospitals to support residency training—at least in theory. However, there are no directives linking the amount of Medicare IME or DME payments a hospital must appropriate to or expend on its various residency programs. Additionally, these federal financing streams may indirectly encourage physicians to pursue lengthy specialty training, focused on medical procedures, and encourage residents to practice in urban settings, since these hospitals are generally located in large metropolitan cities.

States vary in their financial support of residency programs. Most commonly, state support is provided through the state-federal matching program known as Medicaid. While states vary in their use of Medicaid dollars, some allocate funds to support residency and other health care personnel training efforts. Just as with Medicare dollars, strong controls are in place to govern a state's allocation of Medicaid funding. However, few if any controls are in place to ensure that hospitals utilize the funds they receive to support residency programs. This has resulted in residency programs focused on service rather than education.

While the financing of graduate medical education is primarily the purview of teaching hospitals, the education provided in residency programs is directed by medical school faculty or through consortia arrangements of local practicing physicians who serve as faculty for the residency programs. This too, may play a role in determining the kinds of physicians that are being produced. National accreditation sets the standards for the education of the various medical specialty programs. While these standards vary by specialty, there is recognition and acceptance that they are rigorous. Residency programs must maintain national accreditation, or risk having their graduates be unable to obtain state medical licenses or qualify to take national board certification examinations.

New restrictions on residency programs were imposed by the accrediting bodies following the publication of the Institute of Medicine's 1999 report, "To Err is Human," which found that tired and overworked hospital personnel, including resident physicians, had higher incidents of making medical errors (Institute of Medicine Report, 2000). The report suggested that the number of hours residents were required to work had a significant impact on the number of medical errors made. In July 2003, limitations were imposed to restrict the number of on-duty hours for residents. A resident's maximum training activity was set at an average work week of 80 hours.

Implementation of resident work limits led to increased numbers of mid-level health care providers, such as nurse practitioners and physician assistants, filling in the service gaps that resulted. Since the 80-hour limit has been in place, medical students have expressed concern regarding increased responsibilities and expectations of responsibility, suggesting that they might also be filling the void left by the reduction in resident hours. The 80 hour resident restriction may be another cause of the increase in the number of resident positions available. The most recent report indicates that the number of residency programs is at an all-time high with 101,291 residents training in allopathic programs nationally (Brotherton, et al., 2005).

Maldistribution

One of the most persistent problems affecting the U.S. health care system is the unequal distribution of physicians throughout the country, especially in rural areas. The education and training of physicians occurs primarily in large urban centers, and this is where most physicians begin and maintain their practices. What specialty a physician selects and where a physician establishes and maintains his or her medical practice are two questions that have been studied for decades. The questions remain important because physicians do not distribute themselves in the same pattern as the general population. In addition, once physicians begin to practice, they tend to remain in that area, given the economics involved, and do not relocate frequently from region to region, or from state to state.

Texas has approximately 470 residency programs; however not all allow first year residents. There are approximately 1,300 first year residency positions, and 6,000 total positions (Coordinating Board study, 2004). Many, but not all of these residency programs are aligned educationally and/or financially with a medical school, and the majority are located in metropolitan areas. Texas' seven public and one private medical schools graduate an average of 1,300 new physicians annually. However, half of these new physicians leave Texas to enter residency training out of state. Texas imports physicians from other states and IMGs to train in its residency programs.

It has been several decades since research detailed where Texas physicians practice relative to where they complete their medical education and residency training. In 1978 a study at the University of Texas Southwestern Medical Center at Dallas (UT Southwestern) found that for the period 1961 through 1970, 82 percent of medical students originally from Texas and who completed residency training in Texas, ultimately entered practice in Texas (Fact sheet, Texas Higher Education Coordinating Board data, unpublished). In contrast, only 34 percent of physicians who graduated from UT Southwestern, and completed residency training outside of Texas, returned to practice medicine in the state. This report also indicated that 73 percent of medical students from "out of state" who completed residency training in Texas remained in the state to practice.

Typically, these kinds of studies focus on a single medical school and their affiliated residency programs. A study conducted by The University of Texas Medical Branch at Galveston (UTMB Galveston) in 1979 found that for the period 1967 to 1976, 79.6 percent of UTMB Galveston medical graduates who entered a Texas residency program remained in state. Additionally, only 20.4 percent of the medical graduates who completed their residency in another state returned to practice in Texas (Fact sheet, Texas Higher Education Coordinating Board, unpublished). Thus, the strong relationship between location of residency training and location of practice was established. In response to these studies and calls for increased primary care physicians, the state of Texas began funding some residency programs.

Texas provides funding in recognition of the need to train primary care physicians who will provide care to its citizenry. Direct general revenue support for primary care residency training is provided through various programs housed at the Texas Higher Education Coordinating Board (the Coordinating Board). The Coordinating Board allocates funds to primary care residency programs across the state. Providing funds through the agency that oversees higher education is unique to Texas; most other states provide state support for residency programs by providing Medicaid funding for services or allocating state funds through health service agencies or providing funding directly to medical schools. Traditionally state support for Texas graduate medical education came from two funding streams: a state-federal match program under Medicaid and state general revenue funds allocated to the Coordinating Board (about $50 million per year until 2003, when it was reduced to $25 million by the Legislature). The state/federal matching funds were allocated to hospitals for services provided for Medicaid patients, while the Coordinating Board trusteed grant funds are restricted to support primary care residency programs.

In 2005, the 79th Texas Legislature authorized a new formula funding mechanism for health-related institutions in an effort to support graduate medical education. The institutions receive funding for all residents training at affiliated or sponsored programs. Independent residency programs, those not affiliated or sponsored by a health-related institution, did not receive funding. The new funding was provided to support all graduate medical education efforts; it was not limited to primary care. Since state support had previously been limited to primary care, this represented an expansion of state effort. Health-related institutions received $2,395 per resident, with a total available amount of $25 million for the 2006-2007 biennium. The Coordinating Board's Formula Advisory Committee and the Commissioner of Higher Education recommended to the 80th Texas Legislature that this funding be continued. The 80th Legislature responded in May 2006, increasing state support for all graduate medical education through the formula by $32 million or just over $5,000 for each resident trained.

Texas, second in population to California and second in land mass to Alaska, has areas that are both rural and remote. The populations in the rural and remote areas are more likely to be uninsured and must travel greater distances to reach health care services. A majority of Texas rural and remote populations residing in such areas have limited access to health care services. To understand how Texas compares to other states and the nation as a whole, understanding how the federal government assesses health care shortage areas is helpful.

To determine a common national definition of health care access, the federal government in conjunction with state departments of health developed a methodology for determining health professional shortages. The designation, Health Professional Shortage Area (HPSA), indicates that an adequate number and type of health care professionals are not available to populations residing within a specific geographic area. HPSA designations have three categories: dental, mental health, and primary care. Within the primary care HPSA designation there are four types: whole-county, partial-county, population, and facility. Designation as a primary care HPSA is based on the ratio of primary care physicians to county population, factoring in the ability of the county population to access primary care services (i.e., travel time, population density). A primary care whole-county HPSA indicates that the entire county has inadequate access to health care providers, while the partial county designation means that a specified area within a county is underserved, but some portion of the county is adequately served. A facility designation refers to hospitals with high charity care services, such as Dallas county hospital, Parkland's obstetrics/gynecology service, which is designated as a HPSA due to the occurrence of a high number of uninsured births. Prison facilities are often designated as facility HPSAs, based on the large population needing care and the few primary care providers available to provide it.

Of Texas' 254 counties, the Department of State Health Services (DSHS) identified 129 primary care whole-county HPSAs, with nine of these counties under evaluation for withdrawal of the designation (Department of State Health Services, 2005, see Appendix C). An additional 47 primary care partial-county HPSAs were designated in another 16 counties. It is important to note that some counties in Texas might qualify as a HPSA; however they do not have adequate resources to seek the designation. The primary care whole-county HPSA designation serves as a useful proxy to identify areas with little access to primary health care services and allows for comparisons to the rest of the state and the nation.

Statement of the Problem

Texas faces a shortage of primary care physicians and they do not locate their practices in a pattern that reflects the general population of the state. This study provides an assessment of primary care residency training, specifically specialty type and location, and its impact on the current primary care physician workforce in Texas. Hopefully, this will increase the knowledge of current primary care physician practice patterns and present a snapshot comparison of Texas' primary care residency programs by specialty.

Previous studies have evaluated a single medical specialty or residency training within a single medical institution. This dissertation provides a statewide view of primary care graduate medical education. As such, this is the first attempt to link residency training to current practice location on a statewide level. Additionally, this examination will identify the primary care residency programs that produced residents who practice in rural underserved areas, as identified as a whole county HPSA.

Because the state of Texas provides millions of dollars in funding to support primary care residency training through an allocation of trusteed funds to the Coordinating Board and recently incorporated a permanent formula to fund graduate medical education, it is important to better understand the characteristics of residency programs that produce primary care physicians, as they are critical to the state's workforce. Additionally, this greater understanding of residency training should be beneficial to state policymakers in times of limited fiscal resources. However, tracking the physician education pipeline is not an easy or straightforward task.

The length of the physician education pipeline contributes to the difficulty in following or tracking physicians over time. Inherent in the physician education system in any state is loss of physicians to other states between medical school and residency training. Few if any states have policies targeted at providing support for residents in training who show characteristics correlated to state physician workforce goals. Additionally, few states have programs or policies that provide support for residency programs with a track record of producing physicians representing specialties needed by the state.

Research Questions

Research questions for this study were formulated based on two data sets, the Coordinating Board's Primary Care Tracking Survey and the Texas Medical Board's licensure data. The Coordinating Board data present a broad range of information about Texas primary care residency programs and their residents, while the Texas Medical Board data provide additional physician information and current practice location. The two data sets were merged to provide a broad overview of the Texas primary care landscape, as of March 2005. The following questions were addressed using these data.

Which primary care residency programs produce the greatest proportion of physicians that practice in Texas? What characteristics do these programs share (e.g. residency program type, location, sponsorship)? How do various personal characteristics, such as where residents completed their undergraduate and medical education, correlate with practice location in Texas? What influence does gender and ethnicity have on practice location?

Which primary care residency programs produce the greatest proportion of physicians that practice in rural and underserved areas in Texas, as defined as primary care whole-county HPSAs? What characteristics do these programs share? Which residents are more likely to practice in a Texas primary care whole-county HPSA?

Finally, is there a difference among the various primary care specialties in terms of where residents practice?

Hypotheses

Related to staying and practicing in Texas following residency training:

- The percentage of physicians retained in Texas varies by primary care residency specialty.
- Resident physicians who graduate from Texas medical schools have a greater likelihood of practicing in state.
- Gender influences whether primary care physicians practice in Texas.
- International medical graduates (IMGs) are more likely to stay in Texas after completing their residency programs.

Related to practicing in rural Texas:

- Primary care residency programs located in rural populated areas of the state produce primary care physicians that remain in similarly populated areas.

- Family physicians are more likely to practice in smaller, rural communities than are other primary care physicians.

- Women and under-represented resident physicians are less likely to practice in rural Texas.

- International medical graduates are more likely to practice in rural Texas.

Methods

This dissertation presents an overview of Texas primary care physicians who completed residency training during the years 1996 through 2001. Data were collected by the Coordinating Board from an annual year end survey of residency programs. Programs provided an overview of the total numbers of physicians completing their programs and individual information for each resident as he or she completed training.

The Coordinating Board data were then matched to licensure data from the Texas Medical Board's active physician practice data as of March 2005. This resulted in a complete data set of primary care resident physicians in Texas for the study period. Analysis of this data set provided a comprehensive, time-specific snapshot of primary care physicians and their current practice locations.

Elements unique to residency programs, such as location and specialty type, and individual resident characteristics, such as gender, ethnicity, and medical school graduation, were gathered, evaluated, and analyzed to identify outcomes shared by physicians who remained in Texas. These data were examined based on whether these physicians remained in Texas and where they practiced.

Definitions

The following definitions are key in understanding residency training. These definitions have been collected from various resources and serve as a beginning point in understanding physician workforce. These terms will have these definitions when they are used in this dissertation.

Accreditation: A voluntary process of evaluation and review performed by a non-governmental agency of peers (ACGME, Glossary of Terms, 2005).

Accreditation Council on Graduate Medical Education (ACGME): Oversight body for MD aligned residency programs.

Allopathic: referring to MD accredited residency programs or MD education and training.

American Board of Medical Specialties (ABMS): National organization of approved medical specialty boards. The mission of the ABMS is to maintain and improve the quality of medical care by assisting the Member Boards in their efforts to develop and utilize professional and educational standards for the evaluation and certification of physician specialists. The intent of the certification of physicians is to provide assurance to the public that a physician specialist certified by a Member Board of the ABMS has successfully completed an approved educational program and evaluation process which includes an examination designed to assess the knowledge, skills, and experience required to provide quality patient care in that specialty. The ABMS serves to coordinate the activities of its Member Boards and to provide information to the public, the government, the profession and its Members concerning issues involving specialization and certification in medicine (on-line at http://www.abms.org/mission_statement.asp).

American Medical Association (AMA): National professional society for MD medicine.

American Academy of Family Physicians (AAFP): National professional organization of family physicians.

Board certified: designation for a physician who has satisfactorily fulfilled all requirements set forth by the American Board of Medical Specialties for a given specialty.

Categorical Resident: A resident who enters a program with the objective of completing the entire program (ACGME, Glossary of Terms, 2005).

DO: Doctor of Osteopathic medicine. A physician who received a degree from an osteopathic medical school.

Duty-hours: All clinical and academic activities related to a residency program, i.e., patient care (both inpatient and outpatient), administrative duties related to patient care, the provision of patient care, time spent in-house during call activities, and scheduled academic assignments such as conferences (ACGME, Glossary of Terms, 2005).

Family Practice: medical specialty which provides continuing, comprehensive health care for the individual and family. It is a specialty that integrates the biological, clinical and behavioral sciences. The scope of family medicine encompasses all ages, both sexes, each organ system and every disease entity. (1986) (2005) (from American Academy of Family Physicians, accessed on-line at www.aafp.org)

Fellow: A physician in a program of graduate medical education accredited by the ACGME who has completed the requirements for eligibility for first board certification in the specialty. Such physicians are also termed subspecialty residents. Other uses of the term "fellow" require modifiers for precision and clarity, e.g., research fellow (ACGME, Glossary of Terms, 2005).

Gatekeeper: primary care practitioner in managed care organizations who determines whether the patient needs to see a specialist or requires other non-routine services. The goal is to guide the patient to appropriate services while avoiding unnecessary and costly referrals to specialists. (page 10, National Health Policy Forum, May 20, 2005).

Graduate Medical Education: 1) The period of didactic and clinical education in a medical specialty which follows the completion of a recognized undergraduate medical education and which prepares physicians for the independent practice of medicine, also referred to as residency education. (from ACGME); 2) medical education after receipt of the doctor of medicine (MD) or equivalent degree, including the education received as an intern, resident (which involves training in a specialty), or fellow, as well as continuing medical education. The Centers for Medicare and Medicaid Services partly finances GME through Medicare direct and indirect payments. (from May 20, 2005, National Health Policy Forum).

Institute of Medicine: Chartered in 1970 by the National Academy of Sciences to enlist distinguished members of the appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under both the Academy's 1863 congressional charter responsibility to be an advisor to the federal government and its own initiative in identifying issues of medical care, research, and education (Institute of Medicine, 1996).

Internal Medicine: the discipline encompassing the study and practice of health promotion, disease prevention, diagnosis, care, and treatment of men and women from adolescence to old age, during health and all stages of illness. Intrinsic to the discipline are scientific knowledge, the scientific method of problem solving, evidence-based decision making, a commitment to lifelong learning, and an attitude of caring that is derived from humanistic and professional values (from ACGME, Internal Medicine's Residency Requirements, accessed on-line at www.acgme.org)

International Medical Graduate (IMG): A graduate from a medical school outside the United States and Canada (and not accredited by the Liaison Committee on Medical Education). IMGs may be citizens of the United States who chose to be educated elsewhere or non-citizens who were admitted to the United States by U.S. Immigration authorities. All IMGs should undertake residency education in the United States before they can obtain a license to practice medicine in the United States even if they were fully educated, licensed and practicing in another country. (Accreditation Council on Graduate Medical Education, Glossary of Terms, 2005).

Liaison Committee on Medical Education (LCME): Agency co-sponsored by the American Medical Association and the Association of American Medical Colleges, with participation from the Canadian Medical Association for schools in Canada, that accredits education programs in allopathic schools of medicine in the United States and Canada. Allopathic schools of medicine grant a doctor of medicine (M.D.) degree. (Accreditation Council on Graduate Medical Education, Glossary of Terms, 2005).

MD: Doctor of Medicine. A physician who received a degree from one of the United States or Canadian medical schools accredited by the Liaison Committee on Medical Education or from a foreign medical school.

Medical school affiliation: A formal relationship between a medical school and a sponsoring institution [this may include hospitals or foundations comprised of supervising physicians]. (Accreditation Council on Graduate Medical Education, Glossary of Terms, 2005).

National Resident Matching Program (NRMP): A private, not-for-profit corporation established in 1952 to provide a uniform date of appointment to positions in graduate medical education in the United States. Five organizations sponsor the NRMP: the American Board of Medical Specialties, the American Medical Association, the Association of American Medical Colleges, the American Hospital Association, and the Council of Medical Specialty Societies. (Accreditation Council on Graduate Medical Education, Glossary of Terms, 2005).

Obstetricians-Gynecologists: Physicians who, by virtue of satisfactory completion of a defined course of graduate medical education and appropriate certification, possess special knowledge, skills and professional capability in the medical and surgical care of the female reproductive system and associated disorders, such that it distinguishes them from other physicians and enables them to serve as consultants to other physicians and as primary physicians for women. (American Board of Obstetricians/Gynecologists, accessed on-line at www.ABOG.org)

Osteopathic Specialty Board Certification: Osteopathic specialty board certification is awarded by the American Osteopathic Association (AOA) Bureau of Osteopathic Specialists. Osteopathic physicians are eligible for certification by one of 18 AOA specialty certifying boards after completing an osteopathic residency program and satisfying requirements defined by an osteopathic specialty. Some boards offer certification in subspecialties or certificates of added qualifications (American Medical Association, accessed on-line at www.ama-assn.org/aps/physcred.html#osteospecialty).

Program: A structured educational experience in graduate medical education designed to conform to the Program Requirements of a particular specialty, satisfactory completion of which may result in eligibility for board certification (Accreditation Council on Graduate Medical Education, Glossary of Terms, 2005).

Primary Care: Provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community (Institute of Medicine, 1994:15).

Pediatrics: the medical specialty focused on the physical, emotional, and social health of infants, children, adolescents, and young adults from birth to 21 years. Developmentally oriented and trained in skilled assessment, their patient-care lens is focused on prevention, detection, and management of physical, behavioral, developmental, and social problems that affect children (from Pediatrics 101, AAP.org, accessed on-line at www.aap.org).

Osteopathic: referring to DO accredited residency programs or DO education and training.

Resident: A physician in an accredited graduate medical education program.

Subspecialty program: A structured educational experience following completion of a prerequisite specialty program in graduate medical education designed to conform to the Program Requirements of a particular subspecialty. An example of a sub-specialty is cardiology, which requires a resident to have internal medicine residency training prior to entering residency training in cardiology (Accreditation Council on Graduate Medical Education, Glossary of Terms, 2005).

Significance of Study

Understanding where primary care resident physicians practice medicine following completion of residency training could potentially influence future state resource allocation for education and training of physicians in Texas. Because federal and state funding is more difficult to obtain than in the past, this study will provide decision makers with statewide data about the critically important primary care medical specialties.

At the federal level, funding for GME has been curtailed through caps on the number of residents supported under the Medicare program. Additionally, in response to calls to decrease medical errors, national medical groups called for residency programs to implement a reduction in the hours residents may work. This resulted in the medical profession self-imposing an 80 hour work week for residents. In Texas, pressures to reduce property taxes combined with required changes to public school finance have resulted in limited state resources. This is likely to lead to continued discussion and possible budget cuts, which may affect state support of graduate medical education.

Summary

This dissertation presents an overview of Texas primary care resident physicians who completed residency training during the years 1996 through 2001 and provides a snapshot of where these physicians were practicing as of 2005.

Describing specific program and resident characteristics leads to enhanced understanding of the state's physician workforce. This greater understanding should allow policy makers to craft focused and targeted policies to ensure that resource allocations will lead to the education and training of a health care workforce that best addresses the state's needs and allows for informed workforce planning for the near-term and long-term future. Because the medical education pipeline ends not with graduation from medical school, but with residency training, understanding that state physician workforce is more closely aligned with residency training will allow decision-makers to target scarce resources to programs that have a proven track record of producing physicians who stay in-state and practice in areas of need, such as rural whole county HPSAs.

In Chapter 2, a detailed review of the important literature related to physician workforce studies is provided and related to the existing physician workforce. Additionally, the emergence, development, and current state of primary care and other medical specialties is presented. Previous studies of physician distribution are presented and serve as context for this study. The review of the literature will provide further depth and add context to the development of the research questions. The important developments in physician workforce will be described and related to the existing physician workforce. The Texas physician workforce is also described. Chapter 3, Methods, presents an explanation of how the data sets were collected, cleaned, merged, and reviewed. Additionally, the various statistical methods used to analyze the data are presented. In Chapter 4, a discussion of the specific findings is developed. In the final chapter, Discussion and Summary, the implications of the findings are presented, along with conclusions and resulting questions and possible directions for future research.

CHAPTER 2

Review of Related Literature

Issues related to physician workforce have concerned educators, researchers, and policy makers for the past century. A review of several decades of research on the physician workforce provides a framework for this study. Such studies include broad national and state-level analyses of aggregate supply and demand, and more focused research related to medical school efforts in the production of physicians and how admissions policies shape the existing physician workforce. Such research presents snapshots, evaluations, and predictions related to supply and need for the future from various perspectives. As a result, the literature on physician workforce is substantial.

The review of the related literature presents an historical description of the current physician workforce, including an overview of various factors that have shaped its landscape. These factors include medical school enrollments and demographic changes, the role of women in medicine, and the continued need for a workforce that reflects the general population in racial and ethnic diversity. Some studies present approaches to increase or decrease the numbers of physicians entering particular medical specialties. Often such studies encourage incorporating strategies based on personal characteristics and experiences, such as gender and ethnicity or location of upbringing, while others suggest strategies to influence practice location, such as loan repayment programs, that offer incentive to locate in particular areas. Many physician workforce studies have provided recommendations to address specific concerns, such as the need for more primary care physicians, while others focused on the evaluation of efforts and strategies to manage predicted physician surpluses and shortages. Reviewing the physician workforce as a continuum allows for an assessment of professional, governmental, and market forces that have shaped the nation's physician landscape.

Flexner's Report Sets the Standard

Prior to the turn of the 20th century, the education of physicians was not closely regulated, and physicians' education and training experiences were varied. The first systematic review of medical education in the U.S. was conducted by Abraham Flexner and his was perhaps the most influential voice in the standardization of U.S. medicine. Flexner visited and wrote summary evaluations of 155 U.S. medical schools and delivered state-by-state findings. His seminal report issued by the Carnegie Foundation in 1910 presented an evaluation of each state's medical schools in operation at the time (Flexner, 1972 reprint). Flexner's report included recommendations for the ideal medical school, based on the model of Johns Hopkins. His recommendations were hailed by physicians of the day and continue to be reaffirmed today.

The Flexner report resulted in establishing the standard links between medical schools, universities, and hospitals; thus, intertwining the education and training of physicians through the provision of health care service. Notably, some questioned Flexner's qualifications to conduct the study, pointing out that Flexner was neither a physician, nor taught at a medical school (Goodman & Musgrave, 1992, excerpt accessed on-line at www.ncpa.org). Additionally, they and others suggested that Flexner's viewpoint simply mirrored that of professional medicine of the day, as developed by the

American Medical Association (Goodman & Musgrave; Beck, 2004, p. 2139-2140; Stevens, 1998, p.66-78). The view of many in professional and academic medicine during the early 1900s was that the profession would never gain prestige until substandard schools, and those who attended them, were driven out of medicine (Flexner, reprint, 1972; Star, 1982, p.117-124; Stevens, p.55-71). Flexner's Report was a catalyst for academic medical education reforms.

Flexner's influence is most often regarded as positive, as it raised academic rigor and placed scientific research as a cornerstone of medical education. However, a significant decrease in the number of medical schools operating in the years following his report was another outcome. By the time Flexner's Report was published, 18 of the 155 schools he reviewed had closed. In the decade following the Report, another 52 schools shut their doors. In the latter part of the 1800s, seventeen medical colleges for women had opened; but by the end of 1910, only three remained. Similarly, prior to Flexner's report, there were seven medical schools for Blacks; after the report only two, Meharry and Howard, continued (Star, 1982, p.117-120; Stevens, 1998, p.71). Many of the medical schools that closed during the early part of the 20th century were fly-by-night operations at best, with some run by self-declared physicians. Certainly, medical education of that era had room for improvement.

While the results of the Flexner Report were positive in many ways, some have noted that the report marks the beginning point in the development of an educational system that prepared too few physicians for a growing U.S. population and elevated the educational expectations to heights unattainable by most people (Stevens, 1998, p.90-93;

Star, 1982, p.119-125). The rapid closure of medical schools located in smaller, more rural communities, which occurred following publication of the Report led to geographic maldistribution. (Beck, 2004, p.2140; Star, p.124-125).

Interestingly, Flexner's review of Texas predicted a positive future, "Texas is indubitably a state destined to a great development." (Flexner reprint, 1972, p.312). However, he noted that only one of the four Texas medical schools in operation at the time should be continued. That was the medical school in Galveston, a part of The University of Texas. Also, notable was Flexner's observation that the Galveston school would have been better situated if it had been placed in Austin (Flexner, p.312).

Following the publication of the Flexner Report, the medical schools that survived were more similar in their approaches to medical education. Eventually, these schools implemented Flexner's curricular recommendations, and became the institutional foundation of U.S medical education. The Flexner Report described an approach to medical education that required students to spend time in hospitals; thus paving the way for residency programs and graduate medical education. Another significant result of the Report was the turn away from the education and training of the general practice physician and the rise of the specialist (Blondell, Mason, Looney, & James, 1993; Star, 1982, p.78-79, 118; Stevens, 1998, p.115-124). As mentioned previously, however, the closure of medical schools during the first half of the 20th century reduced the total number of physicians available to care for a growing U.S. population. Importantly, implementation of the Flexner reforms effectively shut out women and minorities from careers in medicine, essentially removing them from the medical education pipeline until educational reforms were implemented in the 1960s.

The Current Physician Workforce

Over the last century, the physician workforce changed significantly. Increased knowledge and understanding of health and illness led physicians to new and better ways to treat and care for patients. As a result of the relentless pursuit by physicians to gain greater understanding of the human body, a highly specialized physician workforce emerged. This highly skilled workforce is quick to incorporate medical advancements that increase life-span and improve the quality of patients' lives. Directly influencing the physician workforce are medical school enrollments, personal and demographic characteristics of existing and future physicians, medical specialty selection, type and location of residency training programs, and practice location. Exploring the importance of these influences on the supply of physicians is an important step in accurately evaluating the current physician workforce.

Medical School Enrollment

Current medical school enrollments provide an indication of what the next generation of physicians will look like in terms of numbers, and personal and demographic characteristics. If, for example, more students are admitted to medical schools, the resulting physician workforce will eventually reflect this growth. However, because medical school is not directly linked to practice, changes in medical school enrollments take many years to appear in the workforce. U.S. medical school programs are four years in length and once graduated, physicians must complete residency training in order to obtain a license to practice medicine. To complete a residency program, a physician must train for a minimum of three years in a proscribed training program. Therefore, changes in medical school enrollments take at least a decade to show up in the practicing physician workforce.

Enrollments dropped in U.S. medical schools following the Flexner Report. In the early part of the 20th century, the number first year medical students averaged just under 6,000 (AAMC Data Book, 2003, p. 7). This remained the case until World War II, when moderate increases in medical school enrollments occurred. In an effort to deploy needed physicians for the war effort, there were slight increases in the number of medical school graduates during World War II. This occurred through the introduction of accelerated medical programs (AAMC Data Book, p.8). Once World War II ended in 1945, medical schools experienced steady, though small, enrollment growth (AAMC Data Book, p.8). Decades passed without much change.

Social and cultural changes in the 1960s, including the civil rights movement and implementation of national health care for indigent and elderly, combined with national calls to increase scientific pursuits, led to increases and demographic changes in medical school enrollments. These increases continued into the 1970s, prompted by innovations in technology and medical advancements. By 1984, the number of U.S. medical students reached an all-time high of 67,327. However, enrollments peaked at this point, and for the next twenty years they remained flat, at just under 67,000 (AAMC Data Book, 2003, p.8).

The AAMC report, “Help Wanted: More Doctors,” presents data that show the number of U.S. medical school graduates remained flat at 16,000 from 1980 through 2005 (AAMC, 2006a, p.3). This report notes that while enrollments remained flat, the U.S. population grew by 31 percent (AAMC, 2006a, p.9). The number of first-year MD students per 100,000 population actually declined from 7.3 in 1980 to 5.6 in 2005 (AAMC, p.9). This study suggests that the U.S. MD granting medical school enrollments have not kept pace with an expanding general population. However, these institutions are not the sole source of potential medical residents, the physician population that eventually practice medicine.

Osteopathic medical schools also produce physician graduates that enter residency training, obtain licenses, and practice medicine. In 2000, there were 19 osteopathic medical schools operating; by 2006, 22 were in operation, with four additional branch campus locations (American College of Osteopathic Medicine, 2007, p.1; Salzburg & Foote, 2002, p.167). Graduation rates at these schools, which grant the DO degree, increased from 1,000 graduates in 1980 to 3,000 in 2006 (AAMC, 2006a, p.4). However, the numbers of osteopathic medical students were low initially, so the increase, while significant in percentage terms, had little effect on the total numbers of medical students educated. Graduates of osteopathic medical schools apply to and may train in residency programs accredited through the Accreditation Council on Graduate Medical Education (ACGME) or in osteopathic residency programs. The ACGME is nationally recognized as the accrediting body for the vast majority of graduate medical education programs in the U.S. All MD graduates must enter ACGME residency training programs, but ACGME programs are also open to osteopathic and internationally trained physicians. Osteopathic medicine offers residency programs that accept only DO graduates. The majority of DO graduates train in ACGME residency programs, and these numbers are increasing due to the increases in the numbers of DO graduates nationally (AAMC, p.4). Additionally, efforts are underway to dually accredit some residency programs by both the ACGME and the American Osteopathic Association. Another group eligible to enter ACGME residency programs is international medical graduates.

International Medical Graduates

Another entry into the U.S. physician workforce is available for those who receive medical degrees from schools outside the U.S. This group is called international medical graduates (IMGs) and includes both U.S. citizens who complete their medical degrees abroad and foreign nationals who enter the U.S. following medical school to pursue residency training. The growth of IMGs entering U.S. residency training began in the 1960s when the federal government implemented policy changes that allowed foreign-trained physicians expanded entry into U.S. medical residency programs (Center for Health Policy Studies, American Medical Association, 1973, p.62). At the time U.S. medical schools were not graduating enough physicians to fill all the available positions in hospital residency programs (Mullen, Politzer, & Howard, 1995, p.1521).

In 1963, IMGs represented just over 10 percent of the physician workforce, but by the early 1990s, they comprised 25 percent (Salzburg & Forte, 2002, p.167). This influx of foreign-educated physicians led to a system in which IMGs enter residency programs that have unfilled positions, often because the programs were unable to attract their first-choice U.S. medical graduates. In a 1996 Institute of Medicine report to Congress, Don Deter and Neal Vanselow explained that the number of IMGs had increased to fill the increase in the number of available residency positions (p.4). They noted that the number of U.S. medical graduates had remained stable since the 1980s, but between 1988 and 1993, the number of IMGs in residency training increased by 80 percent (from 12,433 to 22,706) and a majority (75 percent) of these physicians would remain and enter practice in the U.S. (Deter & Vanselow, p.4). Additionally, these foreign trained physicians tended to practice in areas that were less attractive to U.S. medical graduates, such as state mental hospitals. The influx of foreign trained physicians has continued for forty years, with IMGs now making up a quarter of the practicing U.S. physician population (Salsberg & Forte, 2002, p.167; Mullan, 2005, p.1812; Norcini, McKinley, & Anderson, p.S112).

Because foreign educational standards and curricular requirements differ from those of U.S. medical schools, all IMGs who seek entrance into a U.S. residency program must obtain national certification prior to entering residency training. The Educational Commission for Foreign Medical Graduates (ECFMG) is the national organization that provides certification for all foreign trained applicants seeking a residency position in a U.S. program. The ECFME evaluates the educational credentials for each IMG applicant and provides required examinations. In 1983, the number of ECFMG applicants who sought initial entry into U.S. residency training programs was 7,362; however, only 3,885 received certification (McAvenue, Boulet, Kelly, Seeling & Opaleck, 2005, p.475). Significant fluctuations in the number of ECFMG certifications awarded occurred during the twenty year period 1983 through 2002, from a low in 1983 of just 3,885 to a high of 12, 246 in 1992 (McAvenue, et al., 2005, p.475). McAvenue, et al., noted that the overwhelming majority (83 percent) of the 143,926 of those seeking ECFMG certification were foreign nationals. However, the number of U.S. citizens graduating from foreign medical schools is increasing also.

Current data from the ECFMC show that the number of U.S. IMGs (U.S. citizens who graduate from foreign medical schools) applying for ECFMG certification is rising and that schools in the Caribbean area vary in their ability to prepare graduates to meet the requirements to enter a U.S. residency program (Norcini, McKinley &Anderson, 2006, p.S112).   In 1998, there were less than 1,000 of these graduates applying for ECFMG certification, and by 2002, there were close to 1,500 (McAvenue, et al., p.475). More than half of U.S. IMGs who obtain ECFMG certification and train in residency programs received their medical degrees from schools located in the Caribbean countries of Grenada, Dominica, the Dominican Republic, and the Netherlands Antilles (McAvenue, et al., p.476). Additionally, many U.S. students attended medical school in Mexico. Mullan noted that U.S. IMGs comprised three percent (25,380) of the total U.S. 2004 physician workforce (2005, p.1812).

Of the foreign national IMGs, one notable group is the physicians who emigrated from India. Researcher Fitzhugh Mullen reported on India's Medical Education system in, "Doctors for the World: Indian Physician Emigration," (2006, p.380-393). Mullen reported that India graduates 24,000 physicians annually (p.386), which is significantly more than from U.S. MD granting medical schools (15,633 in 2002) (AAMC, 2002, p.8). Additionally, Mullen reported that in India post-graduate specialization is highly regarded by the physician and patient populations. He estimated that less than half of India's annual graduates could obtain residency positions in India, increasing the likelihood that these physicians would pursue additional training abroad (Mullan, p.386). Mullen found that 5,000 graduates of Indian medical schools are currently training in U.S. residency programs, with approximately 1,200 entering annually (p.386). In the current U.S. physician workforce, IMGs comprise approximately 25 percent of all residents in training and of practicing physicians. Indian physicians make up the largest group of foreign national IMGs, with more than 40,000 or 5 percent of total IMGs (Mullan & Fitzhugh, 2005, p.1812).

Changes in medical school enrollments and emigration of physicians educated abroad have a direct influence on the physician workforce. The demographic characteristics of students enrolled in medical schools reflect the changes that will occur in the future physician workforce. While the aggregate number of students enrolled in MD programs has not increased over the last twenty years, the characteristics of students pursing MD degrees have. Most notably, women have enrolled in MD granting institutions in far greater numbers than ever before.

Women in Medicine

Women applied to, were accepted by, and matriculated in medical schools in increasing numbers over the last forty years (AAMC Data Book, 2003, p.23). In 1960, women represented 5.8 percent of total medical school enrollment. By 1970, this percent had almost doubled to 10 percent, and by 2000, women represented 45 percent of total enrollment (AAMC Data Book, p.24). In 2003, the percentage of women applicants to medical school exceeded that for men (at 50.8 percent and 49.2 percent respectively) (AAMC, 2007, on-line data). While significant increases have occurred in the number of women enrolled and graduating from medical school, it will be several years before parity is reached in the practice setting. Nationally, and in Texas, women make up 25 percent of practicing physicians (American Medical Association, 2006a, on-line data; Texas Medical Board, 2006, on-line data).

Gender parity in the practice setting will have an impact on patient care, as research shows that women approach the workplace differently than do their male peers. Wendy Levinson and colleague, Nicole Lurie, explored how the feminization of medicine would shape the future physician workforce (2004, p.471). They found that women spent more time with patients, and were more likely to engage patients as active partners in their care (Levinson & Lurie, p. 471). Additionally, their research concluded that female physicians offered patients more emotional support, encouragement, and reassurance than male physicians. Interestingly, they found this did not translate to higher patient satisfaction (Levinson & Lurie, p.471). Levinson and Lurie also raised concerns regarding the possible decline in the status of physicians, pointing to the low-status of physicians in Russia and Estonia, where women physicians dominate the profession (p.474).

Research on gender differences and medical specialty selection is also receiving attention and provides supporting evidence that women are entering lower-status areas of medicine. In 2005, Garibaldi, Popkave, and Bylsma analyzed internal medicine residents' specialty choices and found significant differences in career plans between men and women (Garibaldi, Popkave, & Bylsma, p.507-512). They reported that women were more likely than men to seek careers in general medicine and less likely to pursue subspecialty training or basic research (Garibaldi, et al., p.510). When women did select subspecialty areas of internal medicine, their choices differed from men. Women who chose to sub-specialize were more likely than their male counterparts to pursue careers in endocrinology, rheumatology, hematology/oncology, infectious diseases and geriatrics. Notably, these specialty areas are not highly paid. Women were also less likely to pursue high-income specialties such as cardiology and gastroenterology. Garibaldi, et al., reported that women were more likely to cite more time with family as an important reason for their career selection (p.510).

Women physicians may be more satisfied with their medical career choices than their male peers. McMurray and colleagues studied the work lives of women physicians and found that women were more likely than men to report being satisfied with their profession (McMurray, et al, 2006, p.372-380). However, they also found that women physicians made less money than their male counterparts--on average $22,000 less.

Additionally, women were more likely to work part-time (22 percent) compared to men (nine percent) (McMurray, et al, p.374).

How changes in the gender composition of the physician workforce will affect health care service and the need for physicians are issues currently receiving the attention of researchers at the state level. Recent work has been published related to the "feminization of medicine" in Texas (Texas Department of State Health Services, 2006, p.1). This report raised concerns about the practice location of women physicians in the state, suggesting that women physicians were less likely than men to locate and practice in rural counties. The report concludes that Texas women physicians were less likely to work full-time, suggesting that increased numbers of physicians would be needed to maintain current access levels to health care services (Texas Department of State Health Services, p.8).

Physician distribution is a concern as it relates to the increase in women physicians. In 1995, Peter West and his colleagues began to consider whether the training of more women in family medicine would result in fewer rural practitioners (West, et al., 1996, p.104). Their research analyzed the location patterns of family physicians who completed residency training at the University of Washington. West, et al., asked the following questions:

1. What are the common geographic and temporal career paths of family physicians?
2. To what extent are sex and year of residency graduation associated with the choice of either rural or urban practice and with the duration of each practice in a given setting?

3. What part does a physician's prior practice experience, sex, and year of graduation play in predicting the location and duration of subsequent practices? (p.101).

They found that women were less likely than their male peers to locate in rural communities (West, et al., p.104). Ellsbury and colleagues also researched family medicine, women, and rural location (Ellsbury, Doescher, & Hart, 2000, p.331-337) and had similar findings.

Concerned that increased numbers of female physicians graduating from U.S. medical schools would exacerbate the rural physician shortage, Ellsbury, et al., analyzed the American Medical Association (AMA) master file of practicing physicians, focusing on family or general practice physicians. They reviewed the 1996 AMA data on MDs who graduated from medical school from 1988 through 1996. Their research sought to identify similarities and differences among medical schools in their production of women physicians in rural areas. They noted that women comprised only 2.8 percent of physicians practicing in rural communities, and that a majority of these women graduated from a handful, 17, of the 125 medical schools (Ellsbury, et al., p.335). Ellsbury, et al., found that two of Texas' seven allopathic medical schools were among the 17 (See Table 2.1). Female graduates of Texas A&M University Health Science Center's School of Medicine, which currently operates campuses in College Station and Temple, neither of which is a large metropolitan area, and The University of Texas Health Science Center at San Antonio, which is a large urban center, prepared the greatest percentage of rural women physicians in Texas.

Table 2.1. *Texas Medical Schools and Women Graduates*

Texas Medical School	Ownership	Total # of Listed Graduates	Graduates: AMA-listed Male Rural FPs and GPs		Graduates: AMA-listed Female Rural FPs and GPs	
			#	%	#	%
Baylor College of Medicine	Private	555	9	1.6	4	0.7
Texas A&M University, School of Medicine	**Public**	**167**	**7**	**4.2**	**4**	**2.4**
Texas Tech University Health Sciences Center, School of Medicine	Public	381	21	5.5	4	1.0
UT Medical Branch at Galveston	Public	674	14	2.1	4	0.6
UT Health Science Center Houston	Public	685	11	1.6	4	0.6
UT Health Science Center, San Antonio	**Public**	**720**	**17**	**2.4**	**12**	**1.7**
University of Texas Southwestern Medical Center at Dallas	Public	691	9	1.3	3	0.4

Source: Ellsbury, et. al., 2000

Ellsbury, et al., found that the medical schools producing the greatest numbers of rural physicians, including women, were public institutions (p.335). They suggest this may mean that public schools are more responsive to workforce needs than are private schools. The authors also note that the increased number of women entering medical school may continue in the coming years, and exacerbate the maldistribution problem in rural areas. Interestingly, Ellsbury, et al., did not analyze residency training sites as they relate to rural practice, nor did they analyze osteopathic medical school graduates. Residency program location is thought to relate to practice location and osteopathic medical schools, though low in enrollments nationally, often have institutional missions to train rural physicians.

Underrepresented Minorities in Medicine

Another area of concern to researchers and policymakers is the race and ethnicity of the physician workforce. The specific problem is that the distribution of physicians by race and ethnicity does not reflect that of the general population (AAMC Data Book, 2003, p.9). In 2003, Jordan Cohen identified four pragmatic reasons for increasing minority representation in medical schools (excluding those of equity and fairness). These included: 1) advancing cultural competency, 2) increasing access to high quality health care services, 3) strengthening the medial research agenda, and 4) ensuring optimal management of the health care system (Cohen, 2003, p.1143-1149). In 1999, African Americans represented 12 percent of the U.S. population, but only 2.6 percent of the physician workforce; similarly, Hispanics comprised roughly 12 percent of the total population, but only 3.5 percent of the physician workforce (Cohen, p.1143). Asian-Americans (represented 4 percent of the U.S. population) are considered overrepresented in medical school, as they comprised just over 9 percent of the physician workforce and 20 percent of medical school matriculants (Cohen, p.1145).

The American Medical Association defines underrepresented minorities in medicine (URMs) as those identifying themselves as African-Americans (Blacks), Hispanics, and Native American Indians (AAMC Data Book, p.12). The Texas physician population does not reflect that of the race and ethnicity of the general population and this has been the case for many decades (Texas Medical Board, 2006, accessed on-line). In 2000, African-Americans comprised 11.6 percent of the Texas population, but only 4.3 percent of the Texas physician workforce; similarly, Hispanics comprised 32 percent pf the Texas population, but only 11 percent of the practicing physician workforce. This issue continues to be a concern to policy-makers, and may be a greater concern as the Texas general population becomes more racially and ethnically diverse.

Komaromy and colleagues reviewed California's physician demographics and found that Black and Hispanic physicians located their practices in areas with higher proportions of residents from underserved minority groups (Komaromy, et al, 1996, p.1308). Importantly, these underrepresented minority physicians treat more uninsured and under-insured populations. The researchers also found that underrepresented minority physicians were less likely to locate in rural or remote communities.

Gang Xu and colleagues studied whether minority generalist physicians (family physicians, internists, pediatricians) provide more care to underserved populations than their white counterparts (Xu, et al., 1997, p.817-822). Their study examined data from 158 MDs who had graduated from medical school in 1983. They found that the physicians from underserved populations were more likely to provide care for underserved populations, when controlling for gender, childhood family income, childhood residence and service and loan obligations (Xu, et al., p.819).

Preference for race concordance was explored by Saha and colleagues (Saha, Tagget, Komaromy, & Bindman , 2000, p.78-79). Their research found that Black and Hispanic patients preferred to see physicians of their same race when given a choice to do so. Nearly 25 percent of the Blacks and Hispanics patients interviewed in their study reported that they "explicitly considered" physician race or ethnicity when selecting their physician (Saha, et al., p.79). The authors concluded that increasing the number of underrepresented minority physicians would respond to market desire (Saha, et al., p.79). However, research conducted by Jason Schnittker and Ke Liang found that while race concordance was desirable by some underrepresented minorities, it had no significant influence on perceived health care (Schnittker & Liang, 2006, p.832). They concluded that additional studies were needed in this area.

While some patients may desire a more diverse physician workforce, recent efforts to increase the diversity of the U.S. physician workforce have been unsuccessful. In 1994, a record number of medical applications were received by the 126 MD medical schools open at that time, including more than 5,000 from minority applicants (AAMC press release, 1994). These gains were thought to be a result of the 1991 effort initiated by the Association of American Medical Colleges (AAMC). The effort, "Project 3000 by 2000" was started as a way to address the low numbers of underrepresented minorities enrolling in medical schools. The project's goal was to have 3,000 underrepresented minority students enrolled in medical school by the year 2000. However, the increases did not continue. The Project's goal was not achieved; in September, 2000, only 1,700 individuals from underrepresented groups entered medical school. The AAMC ended the initiative in early 2000 partly in response to the challenges in the courts to affirmative action admissions policies. However, the AAMC released a statement confirming its commitment to continue its support for increasing the diversity of medical school enrollments.

In fall 2006, the AAMC began promoting a new national initiative, AspiringDocs.org, which is an interactive online outreach campaign with a goal to, "raise awareness of the critical need for more diversity in medicine and to encourage well-prepared African-American, Latino/a, and Native American students to apply to and enroll in medical school." (AAMC, 2006, accessed on-line) In addition to the website, which is open to the public, the AAMC is piloting a two-year outreach effort at four colleges and universities. The outreach effort will target resources to students identified as potential medical students. Four higher education institutions were selected to participate: the University of Arizona; California State University, Fresno; the University of Pittsburgh; and Rutgers, the State University of New Jersey. These institutions were identified as having large numbers of undergraduate minority biology majors, few of whom entered medical schools (AAMC, 2006d, accessed on-line). The pilot aims to reverse this trend and increase the numbers of minority biology students enrolling in medical school. Following the two-year pilot, the effort will be evaluated for possible expansion to other campuses.

Medical Specialization

The current physician workforce reflects medical specialty residency choices made by practicing physicians in years past. Because the length of residency training adds many years to the training pipeline, residency selection choices provide insights into the future physician workforce. Medical specialties have emerged and evolved as medical advances have been made, resulting in a physician workforce that is highly specialized and often narrowly focused. A brief history of the development of medical specialties and their relationship to residency training will be presented and serve as context for understanding the existing physician workforce.

As early as the 1880s, technical innovations and medical advancements attracted physicians to begin to study in-depth about a particular disease or organ. This led to the informal emergence and development of medical societies. At that time, physicians who shared similar interests in specific areas of medicine met regularly to discuss their efforts and share information on new procedures and approaches they were using. These groups evolved into specialty societies, and later became professional medical specialty boards, responsible for credentialing physicians within particular specialties (Star, 1982, p.35; Stevens, 1998, p.435). Developments in surgery and ophthalmology led to the establishment of the first medical "specialty" areas and paved the way for others (Stevens, p. 435-337; Star, p.136-142). A multi-layer medical system based on specialization began to emerge, with little coordination among the various entities. Stevens points out that medicine at the time was rapidly transforming itself from a focus on the local doctor caring for the population to the specialized physician of today,

> By 1900 medicine had become characterized by overlapping boards, medical schools, the AMA, the specialist societies, hospital staffs, hospital practice and private practice, and generalists and specialists. The relationships between these blocs bespoke shifting professional patterns and raised continual questions of definition (1998, p. 49).

Contributing to the rise of specialization were academic medical leaders, who were often leaders within emerging specialty societies. These physician leaders encouraged focused medical efforts and often placed greater attention on specific areas of the human body or particular diseases and conditions (Kunitz, 1986, p.16). Also contributing were the findings of the Flexner Report which encouraged strengthening ties between academic medicine and hospitals and establishing the residency model as ideal for the education and training of physicians. Also, helping strengthen the move toward specialization was the building of urban hospitals. In the early 1900s many hospitals were built and relationships were established between them and medical schools (Star, 1982, p.98). Departments within hospitals began to emerge, initially as a way to treat patients with similar ailments. Staffing the newly developing departments were physicians who were increasingly knowledgeable about specific diseases, organs, and surgical procedures. The hospital department provided physicians, who were often medical school faculty members, an opportunity to have medical students and newly graduated physicians (often referred to as "residents") to participate in the application of medicine, with the hospital serving as a "hands-on" lab. Newly trained physicians were given the opportunity to actively observe and treat various patients and conditions and they gained real-life knowledge and experience by providing patient care in the hospital setting. This experience was quickly integrated as an expected part of the educational process (Star, p.98). However, this was a change in the educational model in place at the time.

The vast majority of practicing physicians in the early 1900s were not focused on one area of the human condition, but tackled all medical problems. These physicians practiced the broadest range of medicine and were not considered "specialists:" they were commonly called "general" practitioners. The acceptance by the public and within the medical profession of the role of physician "specialists" changed by the 1930s, when greater numbers of patients began seeking specialty care. Contributing to the promotion and acceptance of the medical specialties and offering definitions of their area of expertise or scope of practice were the various medical specialty boards. Although in place for several years as specialty societies, many medical specialty boards were officially founded in the 1930s including Obstetrics and Gynecology (1930), Pediatrics (1933), and Internal Medicine (1936) (Stevens, 1998, p.47; Starfield, 1992, p.91). These boards autonomously established the content and breadth of their particular medical specialty, and had substantial influence over the residency program experience.

Adding to the rise of medical specialization built on educational standards was the recognition by the U.S. military that many physicians enlisting in World War I were inadequately prepared to practice in their stated area of specialization (Stevens, 1998, p.353). The military responded by encouraging medical specialization, through promotion in rank, of specialized physicians with documented experiences in hospital residency programs. Physicians who were residency trained in a particular area received higher rank than did generalist physicians. Thus, the U.S. military played a key role in encouraging educational standards through residency training.

By the time of U.S. entrance in the World War II, the military had an evaluation system in place that rewarded the education and training of military physician specialists over the general practitioner (Stevens, p.354). Following World War II, federal legislation passed that encouraged the establishment of new medical schools and increases in enrollments at existing schools. Passage of the Serviceman's Readjustment

Act of 1944, commonly referred to as the GI bill, offered returning soldiers opportunities to pursue medicine as a career and provided them with financial incentives to pursue specialized residency training (Star, 1982, p.165, Starfield, 1992, p.2). Additionally, passage and implementation of the Hill-Burton Act in 1946 provided states with funds to open new hospitals and renovate and expand existing hospital infrastructure. As a result, greater numbers of physicians were needed to staff the new and renovated hospitals (Star, p.365), and this resulted in increases in residency programs. Medical specialization became widely accepted as the standard educational model for new physicians after World War II and the public became comfortable with direct access to specialty physicians.

Medical specialty boards have long been involved in defining the educational requirements of their specialty. This grew from the allegiances established in the early days of medical boards with departments in the medical schools and hospitals, as the physicians in the various developing medial specialties differentiated themselves from their colleagues and identified their area of specialization. Such differentiation included proscribing the educational path of future physicians, which included setting standards, such as the number of years required in a residency training setting and passing an examination which evaluated competency upon completion of training. The Flexner Report essentially standardized the basic knowledge required to practice medicine, while the development of the medical specialties brought differentiation into the practice of medicine (Star, 1982, p.285). Today, a physician's medical specialty designation indicates the area of medicine in which he or she practices and serves to inform the public that the individual has completed a minimal set of requirements to practice in that area (American Board of Medical Specialties, 2007, accessed on-line; American Osteopathic Association, Bureau of Osteopathic Medicine, 2007, accessed on-line). In addition to selecting a medical specialty area within which to practice, physicians may obtain the professional credential, “board certified.” Such a designation implies that the physician has achieved minimal levels of specific competencies and maintains the education and training requirements established by the particular medical specialty board (American Board of Medical Specialties [ABMS], accessed on-line at abms.org, Star, 1982, p.125; Stevens, 1998, p.176-180; Starfield, 1992, p. 91-95). Other factors have also played a role in the continued proliferation of medical specialties. Notably, federal policies and programs in the 1960s were implemented to encourage the establishment of new medical schools and provided hospitals with funding mechanisms to support residency programs.

Federal Funding Furthers Specialization

Federal legislation and incentives initiated in the 1960s fueled the establishment of new medical schools, which created more opportunities for medical education and residency training, as greater numbers of specialists were needed to staff the new and expanded hospitals, and advances in surgical procedures and increased use of technology required advanced training for physicians. For example, four of Texas’ eight medical schools were established during the late 1960s and through the 1970s with federal funding support (See Appendix A. Texas Medical Schools). The establishment of new medical schools allowed for the education and training of more physicians. Also, enactment of the federal Medicare and Medicaid programs in 1965 laid the path for continued medical specialization.

The Medicare and Medicaid programs provided financial support for specific populations previously not covered by health insurance (i.e. elderly and disabled; and impoverished). Because these groups were then able to access health cares services, hospital staffing needs increased. Additionally, hospitals that treated these individuals received extra funding if they also operated residency programs. Residency programs were also beneficial to the hospitals because they provided highly trained physicians at reduced costs.

Medicare provides health care services to seniors and a select group of disabled persons, while Medicaid is a state-federal matching program that provides payment for medical services and insurance coverage for chronically ill and indigent populations. Medicare is a federal entitlement program for seniors, while Medicaid is a state-federal match recognized as a state benefit program. These programs essentially established a federal payment system for physicians and hospitals that provided health care services to the covered groups.

Prior to implementation of Medicare, residency programs were financially supported by the hospital in which they were housed. The programs generated revenue through provision of patient care. Implementation of Medicare and Medicaid provided hospitals with financial incentives to create new residency programs or add additional positions to existing programs. The more patients cared for in the teaching hospital, the more federal funding the hospital received. This funding was originally provided as a pass-through payment to hospitals for the costs of residency training, including salaries, benefits, and overhead. However, the funding mechanism was changed in 1983, with the implementation of a new payment method for Medicare, based on a listing of 495 specific diagnostic categories (diagnostics-related groups), which established a payment schedule for each medical procedure performed (Cleverley, 1997, p.15). Teaching hospitals were paid by Medicare for medical procedures performed based on the diagnostics-related group payment schedule, and they received additional funds based on the number of beds filled by Medicare beneficiaries. States implemented these same payment methods for their Medicaid populations. As a result of the Medicare and Medicaid funding provided to support residency training, these federal programs are now inextricably connected to graduate medical education. For example, in 1997 total Medicare payments averaged $72,000 per resident trained (Council on Graduate Medical Education, 2001, p.24-35). While the teaching hospital receives funds for these residents, there is no requirement that the funds provided be expended to develop, maintain, or enhance education at the residency programs (Applebaum, DeAngelis, McAndrews, & Pan, 1996, p.1289).

Current Requirement of Residency Accreditation and Continued Specialization

Accreditation of residency programs plays a significant role in medical specialization. Oversight and review of the various residency specialties is maintained through two national accrediting bodies: one for allopathic residency programs, the

Accreditation Council on Graduate Medical Education (ACGME), an independent arm of the American Medical Association, and one for the osteopathic medical residencies, the Bureau of Professions of the American Osteopathic Association, a section of the American Osteopathic Association. These two accrediting bodies oversee residency training under federation-like structures, with little coordination between the various specialty boards with regard to curricular content. John Petersdorf summarized the organization of residency training in a 1992 speech,

> Residency training consists of a series of isolated residency programs, which are nominally under the jurisdiction of teaching hospitals or medical schools. Functionally, however, each residency program is its own little island. There is very little contact between different residency programs even within a single institution, and comparatively little contact between each of the residencies and the parent institutions. The name of the game is autonomy." (Morris & Garvey, editors, 1993, p.182).

The curriculum, structure, and required experiences of the medical specialties are proscribed by the various independent Residency Review Committees (RRCs) of the ACGME and the Bureau of the Health Professions of the AOA. The RRC for each specialty and subspecialty develops program guidelines and requirements. The compendium for allopathic residency program is called Directory of Medical Education Specialties or the “Green Book.” This directory lists all the educational and programmatic requirements and programs available for the different medical specialties. The specialty may designate a residency program’s organizational structure, number of residents per supervising physician, length of training, and numbers of required procedures (American Medical Association, Directory of Medical Education Specialties, 2002). To maintain accreditation, residency programs must adhere to the standing rules and regulations.

Some collaboration exists in the subspecialty area designations, which requires two accrediting bodies to oversee and recognize the areas. However, these entities weigh in only in their areas of expertise, effectively coordinating rather than truly collaborating on curricular content. For example, the RRC for pediatrics reviews and evaluates residency programs exclusively in pediatrics; however, they work jointly with surgery to evaluate area of pediatric surgical subspecialties (Accreditation Council on Graduate Medical Education, accessed on-line at www.acgme.org).

Additional training programs that combine the competencies of more than one specialty board and residency review committee are collectively called subspecialties. For example, physicians who wish to obtain board certification as a derma-pathologist have to complete a residency in dermatology and then one in pathology. Their training is focused on the pathology of skin. Both the American Board of Dermatology and the American Board of Pathology cooperate in the development and coordination of education and training content requirements, credentialing, and board certification standards in this case (Iserson, 2003, p.56).

The umbrella organizations of the Accreditation Council on Graduate Medical Education and the Bureau of Professions of the AOA provide staffing and administrative offices that support the process of board certification, including scheduled review and evaluation of programs. Additionally, the residency programs must adhere to oversight from their local hospitals, as well as state and federal governments, and maintain positive relationships with faculty, residents, and patients. Between 1996 and 2002, the period of time covered in this study, national accrediting bodies recognized 110 different types of residencies, with oversight of 24 medical boards granting specialty or subspecialty certification (AMA, 1996; AOA, 1995). Residency training has continued to evolve and by 2006, the number of recognized medical specialties increased by 16 to a total of 126, under the oversight of the 24 medical boards (Accreditation Council on Graduate Medical Education, accessed on –line at www.ACGME.org).

A physician may be trained in the specialty areas of primary care (family medicine, internal medicine, pediatrics, and obstetrics/gynecology) or a subspecialty area. Again, within primary care areas physicians may be considered “specialists,” but the term is more commonly used to describe physicians trained in other areas of medicine. For the purpose of this dissertation, the term “medical specialty” refers to the type or kind of medicine a physician practices, including the “specialties” of primary care. Additionally, it is common to call physicians who practice a particular specialty “specialists” whether they practice primary care or another specialty. However, most researchers agree that a medical specialty requires completion of a residency program (i.e., three to seven years of residency training), while a subspecialty requires additional training (i.e., one or more years) following completion of an initial residency. Such subspecialty training often requires physicians to study areas of medicine that have separate accrediting oversight bodies (American Board of Medical Specialties, accessed on-line at www.abms.org). However, subspecialties are often built on the primary care specialties of internal medicine or pediatrics.

The generalist specialties of medicine, the focus of this dissertation, vary in their organizational design. For example the family medicine residency program specialty is three years in length and it must operate a stand-alone clinic. Obstetric/gynecology programs are four years in length and require residents to train in other programs, typically internal medicine, to fulfill their primary care requirement. Various external and internal environmental differences allow for the residency programs to respond to their communities and provide residents with unique training opportunities. External environmental differences include geographic location, (urban/ rural), size of the programs (total number of residents training), location within the community (in hospital/community clinic/other), and specific populations served (indigent, elderly, children). Internal environmental differences include clinic facilities, variations in health care providers employed, and patient care services. These factors influence a program's structure and often determine the kinds and amount of services provided. Patient care services also define a residency program's function within a local community.

Medical Specialization and Geographic Distribution

Medical specialization emerged from increased scientific pursuits and cooperation of groups of physicians with shared interests. It has affected the U.S. health care system in two ways: the numbers of physicians practicing in geographic proximity to the general population have declined, and the numbers of the physicians electing to become general practitioners have also declined (Starfield, 1992, p.92). The general practitioner, the predecessor of today's family physician, served as the model for medicine until the middle of the 20th century (Kunitz, 1986, p.19-27). The general practitioner provided all aspects of medical care, from delivering babies to performing basic surgical procedures, and diagnosing and treating a full range of common illnesses (Kunitz, p.24). Additionally, the general practitioner located and provided medical care for a local community and its general population. This changed with the increase in medical specialties and acceptance of the specialist, which had become the model by the 1960s (Starfield, p.93).

The role of the general practitioner has continued to decrease in the U.S. health care system. The issue of physician distribution serves as a proxy for access to health care for the general population and is based on the premise that a given population has greater likelihood of accessing care if a physician is located in a relatively manageable proximity (Jacoby, 1991, p. 431-432). The reality that the U.S. physician population is not distributed similarly to the general population has plagued health-care policymakers for decades (Jacoby, p.431). The result is that populations in rural and remote areas have limited avenues to obtain health care. The issue dates back to the 1940s, when some rural communities erected billboards to advertise their needs for physicians (Jacoby, p.427).

Beginning in the 1950s, medical scholars began to call for programs to provide more physicians for rural areas. Originally called manpower studies, researchers in the mid-1950s noted that the U.S. population was growing, but physician supply was not keeping pace. There was also recognition that physicians were not locating in patterns similar to the distribution of the general populace; an issue called “maldistribution.” Often noted and problematic was the recognition that newly educated physicians were not locating in rural areas. National leaders began calling for training more general practitioners, as there was agreement that these physicians would be able to care for the broadest range of patients and provide general health care services (Graduate Medical Education National Advisory Committee, 1981; Council On Graduate Medical Education, and Institute of Medicine Report). There was recognition that the traditional role of the general practitioner, which had declined due in part to increased medical specialization following World War II , would be important in providing adequate medical care to citizens living in rural areas.

While medical leaders noted the location of physicians and the corresponding reduction in access to health care services, national policy efforts to solve these problems were not initiated until the 1960s (Jacoby, p.427; Stevens, 1998, p 49; Star, 1982, p.127). Notably, the Hill-Burton Act was the first legislation that attempted to address the lack of available physicians in rural communities. It provided federal financial assistance to such communities to build hospitals (Ebert & Ginzberg, 1988, p.12). However, its role was limited, since it also provided funds for the renovation and building of new urban hospitals. While more hospitals were established in the 1960s, some researchers began writing about the need for a physician to care for the primary needs of the population. Notably, the idea of general medical care provided to a population as "primary care" has its beginnings in the 1960s.

John Geyman and Larry Hart reviewed the literature in an effort to document the history of primary care. They found the term "primary care" used in the 1960s writings of U.S. physician Kerr White, who wrote about the idea of "primary medical care"

(1994). Dr. White based his model of health care on the premise of "population-based heath care" and proposed that in any given month, a certain number of adults in a given population would become ill, and some would seek medical care. Of those who sought care, some predictable number would require hospitalization, while others would need a referral to another kind of physician, and a scant few would need to be sent to a university medical center for highly specialized care (Geyman & Hart, 1994, Star, 1982). Dr. White's writings are linked to the idea that one medical provider should serve as an evaluator of a patient's health care needs and that a system of referrals would introduce greater efficiencies into the system

Researchers were beginning to recognize that physicians were staying in the cities and not practicing in rural areas. By the mid-1960s there was widespread recognition that people in rural and remote areas did not have access to health care equal to their urban counterparts. Two studies published in 1966 illustrated the perceived difficulties of medical specialization and called for the establishment of the medical specialty, "family practice," which leaders hoped would produce physicians who would locate in rural and smaller communities. One of the studies, the Citizens Commission on Graduate Medical Education (called the Millis Report because it was chaired by John Millis, president of Western Reserve University) focused on graduate medical education. It called for a specialty for family physicians. Such physicians would pursue the highest level of training and a residency would be required to obtain the designation. The Millis Report also presented a definition of primary care as being the first contact patients experience in the health care system.

The second report published in 1966 would be remembered for developing the argument to have the specialty of family medicine. "Meeting the Challenge of Family Practice: A Report of the American Medical Association, Ad Hoc Committee on Education for Family Practice," (also known as the Willard Committee) specifically called for increased numbers of physicians to care for the rural population. Actions following the publication of these two reports stimulated efforts to establish family practice as a medical specialty (American Academy of Family Physicians, accessed on-line at www.AAFP.org; Stevens, p.312-314; Blondell, Mason, Looney, & James, p.285). However, the specialty was not officially established until 1969 (Green & Fryer, 2002, p.781).

Once the specialty of family practice was established, researchers began to document that that family physicians were more likely to practice in smaller rural communities (Anderson, Bergeron & Crouse, 1994; Denton, Cobb & Webb, 1989; The Graham Center, accessed on-line at www.graham-center.org). Considerable agreement exists today that the entire spectrum of primary care physicians, and specifically family physicians, is critically needed as they are more likely to locate in sparsely populated rural and remote areas of the country. Researchers Larry Greene and George Fryer found that even though family physicians represented a small part of the entire physician workforce, "the population of the U.S. visits the offices of family physicians and general practitioners more than those of any other medical specialty" (2002, p.782). Similar conclusions have been made related to physicians locating in inner-city areas, notably that minority physicians are more likely to return to practice in inner-city areas and treat underserved populations (Thurmond & Cregler, 1993; Petersdorf, Turner, Nickens & Ready, 1990). Researchers agree that primary care physicians are needed in inner-city areas that have low numbers of physicians available for the population.

National Perspective and Surplus/Shortage of Physicians

Efforts have been made over the years to lend a national perspective to residency training and the effects it has on the physician workforce. In the early 1970s, studies documenting the disparities and potential negative consequences of physician geographic maldistribution were being published which resulted in Congress establishing the Graduate Medical Education National Advisory Committee (GMENAC), in 1976, with a prescribed life of four years. The committee was charged to discover an adequate means of analyzing physician geographic distribution (Jacoby, 1991, p.428-429). GMENAC is credited with establishing the current construct used to evaluate access to health care based on an individual's ability to access health care service within a given time period, i.e. approximately 30 minutes in travel time (Jacoby, p.429). However, GMENAC also concluded that the nation faced a surplus, not a deficit of physicians (McNutt, 1981, p.1116, Salsberg, 2000). In response to the GMENAC recommendations to reduce the number of physicians in the U.S., the allopathic medical schools voluntarily limited their enrollments. However, there was no corresponding limitation on residency training and the number of residents continued to climb, largely through the immigration of IMGs (Salsberg, 2000).

By 1986 Congress authorized the establishment of the Council on Graduate Medical Education (COGME) and charged its members to provide advice and make recommendations to the Secretary of the Department of Health and Human Services and Congress on an array of issues affecting graduate medical education. The Council has a specific directive to study:

1. The supply and distribution of physicians in the U.S.
2. Current and future shortages or excesses of physicians in medical and surgical specialties and subspecialties.
3. Issues relating to international medical school graduates.
4. Appropriate federal polices with respect to the matters specified in items 1-3, including policies concerning changes in the financing of undergraduate and graduate medical education programs and changes in the types of medical education training in GME programs.
5. Appropriate efforts to be carried out by hospitals, schools of medicine, schools of osteopathic medicine, and accrediting bodies with respect to the matters specified in items 1-3, including efforts for changes in undergraduate and GME programs.
6. Deficiencies and needs for improvements in existing data bases concerning the supply and distribution of, and postgraduate training programs for physicians in the U.S. and steps that should be taken to eliminate those deficiencies. (Tenth Report, COGME, 1998, p.19).

Since its establishment, COGME has produced 15 reports concerning resident physicians. However, few of COGME recommendations have been translated into federal policy. Many of the COGME reports have findings similar to those of its predecessor, GMENAC. COGME has called for reductions in the numbers of medical residents trained and for limits on the number of residency positions.

In 1989, Jonathan Weiner evaluated the various approaches taken to assess the adequacy of the U.S. physician workforce, reviewing the work of the Graduate Medical Education National Advisory Committee, the Bureau of Health Professions Education and the Council on Graduate Medical Education. Weiner supported the projection offered by these organizations that a physician surplus was coming (Weiner, 1994, p.224-228). While the common belief of researchers who studied the supply of physicians was that a physician surplus was likely, the implications to the workforce were not well understood and some began to raise questions about those implications.

In 1994, John Eisenberg noted that the “trickle down” policy of physician geographic distribution, the idea that training greater numbers of physicians would eventually lead to some practicing in less desirable rural and underserved urban locations, had not worked. He suggested that current market constructs, such as how Medicare pays hospitals, encourage unequal geographic distribution. Eisenberg noted that because Medicare relies on low priced residents to perform highly profitable procedurally-oriented care, hospitals have little incentive to help new physicians explore the idea of practicing away from large medical centers. He added that this approach continues to produce physicians who are more comfortable in large urban areas, where the most advanced technologies are available. Eisenberg also pointed out that hospitals are encouraged to create more residency programs as a way to cover service needs. He suggested that governmental intervention and payment methods help encourage further specialization. He supported the idea that government must take the lead in changing the way Medicare provides payment to hospitals. Ultimately, he argued that such a policy change would alter the training patterns such that physicians would be encouraged to enter practice in rural and underserved areas. He supported implementation and development of policies that would provide financial incentives to physicians who located in rural communities (Eisenberg, p.244). While Eisenberg focused on the Medicare system and how it influenced physician distribution, other research focused on reducing the number of physicians educated. Due to estimates of a physician surplus, there was general agreement that systemic changes were needed. One such change was to slow the number of U.S. medical students being educated.

Many researchers and physicians in the 1990s advocated reducing the numbers of medical students trained. Most notable was the Pew Health Professions Commission report, "Critical Challenges: Revitalizing The Health Professions For The Twenty-First Century," which called for the closure of medical schools, reduction in the numbers of residents trained and greater restrictions imposed on IMGs (PEW, 1995). It was during this time that others began to question what an over-supply might mean for the workforce. As early as 1996, scholar and physician Peter Setness began to raise questions about the supply of physicians. He took the PEW recommendations and quantified them, indicating that the effects of those recommendations would be to:

> Close enough U.S. medical schools to cut at least 20 percent of first-year slots by the 2005 (i.e., cut the 1995 number of 17,000 students to 14,000);
>
> Limit the number of residency slots to the number of U.S. medical school graduates plus 10 percent (in 1995-96 it was the number of graduates plus 37 percent).
>
> Tighten visa restrictions on IMGs (to encourage them to return to their native countries rather than setting up practice in the U.S.). (Setness,1996).

While Setness reiterated the PEW findings, many felt his handling was less than sensitive. Setness revisited his article in 2001 and stated that while the oversupply had not materialized as predicted, the actual numbers of practicing physicians had increased at rates higher than expected (Setness, 2001, p.10-12). He called for researchers to consider the importance of the increased numbers and craft policy to better address workforce needs (Setness, p.12).

Questions were beginning to emerge in the 1990s about the traditional methodology used to evaluate the physician workforce. That methodology focused on the supply of physicians relative to the general population. For example, David Goodman suggested that just looking at the numbers of physicians practicing medicine was not sufficient to understand the workforce (Goodman, 2005, p.VAR92). He recognized work initiated by Barbara Starfield who introduced the idea of evidence-based workforce assessment. Starfield had questioned whether the supply of physicians resulted in improved health outcomes and found that mortality decreased as the number of primary care physicians increased. Furthermore, when she studied other physician specialties, she found that in areas with high numbers of sub-specialists, mortality increased (Starfield, 1992, p.181). While she noted that many confounding variables might be affecting the results, the questions she and Goodman raise charted new territory in health care workforce planning. Recent analyses of physician workforce have called for the inclusion of evidence that increased access to health care actually results in improvement in the health status of a population or community (Goodman, 2005; Starfield, 1992).

By the mid-2000s researchers would change course, explaining that instead of a surplus, there was a shortage of physicians. This shortage was especially important for rural and inner city areas of the county. While general agreement existed that the numbers of physicians being trained appeared to be adequate on a national scale, the numbers of physicians within particular specialties and in inner-city, rural, and remote areas were recognized as being insufficient. Interested groups began calling for increased medical school class sizes and the establishment of new schools. Nationally, the Association of American Medical Colleges called for a 30 percent increase in the total number of students enrolled in U.S. medical schools. Currently, Texas has three serious efforts to establish new medical schools: one is a four year medical school affiliated with Texas Tech University Health Sciences Center in El Paso; the second is a medical school in the Lower Rio Grande Valley affiliated with The University of Texas Health Science Center at San Antonio; and the third is an expansion of The University of Texas Medical Branch at Galveston into Austin. Additionally, many Texas medical schools have increased their existing class sizes in response.

Importance of the Primary Care Physician

Agreement exists in the physician workforce literature that the primary care provider should be the initial point of contact in the system (Starfield, 1992; Stevens, 1998; Star, 1982; Iserson, 2003, Institute of Medicine, 1974; 1994; 1998; American Medical Association, 1998). General agreement also exists that primary care should be provided by clinicians, commonly thought to be physicians. However the nature of the health care provider at the initial point of contact is changing, as the primary care field of clinicians has expanded since the early 1990s to include nurse practitioners and physician assistants. However, there is also disagreement on just what “initial point of contact” means.

In 1997, researcher Eric Cassell raised questions related to the initial point of contact. Cassell suggests that viewing a returning patient as an initial point of contact each visit limits the physician’s opportunity to serve as a patient’s coordinator of care (p.34). He suggests that the continuum of care must be considered as a factor in physician workforce and policy development.

The primary care physician is trained to consider the whole person, whereas a specialist is trained to consider conditions related to specific organs or diseases. There is general agreement that primary care includes an element of time, that is, the physician/patient relationship develops over a period of years. It is also agreed that primary care physicians are educated and trained to provide initial diagnoses and develop treatment plans for the widest range of patients. Because of their general medical training, patient access to primary care physicians has been promoted and is accepted as a public good that should be provided and available to populations in all communities. However, because physician distribution is not easily managed, access to health care services in rural and remote areas continues to be lower than in large metropolitan areas.

The term “primary care” was expanded in the 1970s to include the types of physicians who provide the initial care and serve as a patient’s first point of contact in the health care system. The rise of Health Maintenance Organization (HMO) plans in the

1980s further refined the term to refer to a specific group of physicians. The notion that training primary care physicians was critical to the nation's health care workforce gained increased attention in the late 1980s and early 1990s. In its Third Report in 1992, the Council on Graduate Medical Education concluded that there was an oversupply of physicians in certain specialties (pathology, anesthesiology) and severe shortages of others (family practice and internal medicine) (Council on Graduate Medical Education, 1992; Rivo, Mays, Katzoff & Kindig, 1995).

It was also during this period that the leaders of several specialties sought recognition as "true" primary care specialties. Barbara Starfield evaluated the state of primary care in the U.S. in her 1992 book, <u>Primary Care, Concept, Evaluation, and Policy</u>. She began her evaluation with the tenet that every health care system has two goals: pursuit and delivery of the best available health care, and distributing health care services to maximize the health status of the populace. Starfield suggested that the role of specialization within medicine is a uniquely American phenomenon. She acknowledged that medical specialization in the U.S. has led to world-recognized and emulated advanced medical technologies; however, she also noted that the system has led to, "spiraling health care costs," (Starfield, p.91-102).

Eric Cassell's 1997 book, <u>Doctoring: The Nature of Primary Care</u>, builds on Starfield's work. Cassell provides a detailed analysis of how technology has widened the gap between physician and patient (p.62-81). By describing the allure of technology for both physicians and patients, he highlights how removed the physician has become from the patient. Cassell acknowledges the positive benefits that advances in technology and procedures have provided and how they allow physicians to diagnose and treat patients in some cases more effectively. However, he recognizes that this has come at both a financial and an emotional cost. Cassell describes how advances in medical technology have characteristics that prompt physicians' sense of wonder and fascination (p. 63-64).

> The first hold that technology has on us I call wonder and wonderment. Every body loves the new and shiny, especially when it does fantastic or seemingly inexplicable things that enthrall us (Cassell, p. 64).

He suggests that this results in physicians continually demanding newer, hopefully better, technologies. Cassell notes that increased reliance on technology, in turn, leads to overuse, and increases costs for all. Additionally, he describes the hold of technology over physicians as it relates to the immediate, i.e. physicians' desire for prompt answers to their questions. Medical technology provides rapid responses, and removes ambiguity, which again leads physicians to rely on it further. Cassell also sees technology as self-perpetuating; as the technology is incorporated, it gains acceptance, which further increases use. Technology also provides physicians with a sense of power, allowing them to state definitely the nature of a patient's condition and that the use of a given technology will resolve it. He also recognizes that technology separates the physician from the patient, because of what he calls "knowledge at a distance." Cassell suggests that the drive for new technology and the increased disconnect between physicians and their patients has contributed to the declining interest in primary care.

Cost was also thought to play a role in the decline of primary care. In 1995, researchers collected operational cost data, which included educational and patient care revenue from ambulatory and non-teaching ambulatory care clinics, in an attempt to measure the extra costs associated with residency training (Boex, et al, 2000). Data collected from 98 ambulatory care clinics in which residency training occurred were compared to data from 84 non-teaching ambulatory care clinics. The findings suggested that teaching residents added 24 percent to the operational costs assigned to educational activities, which included didactic and clinical supervision, and an additional 12 percent for associated costs that could not easily be identified (Boex, et al., p.420). However, Boex, et al., noted there were several limitations to the study. Clinics were selected based on convenience and opportunity, and may not have accurately reflected graduate medical education as a whole. Additionally, he pointed out that the groups compared were unequal in their patient size and suggested that this might be reflected in the findings. Because no centralized national agency or organization exists that collects data on teaching in ambulatory clinics, the researchers developed their own data collection system. This system was not extensively field tested prior to the study. While Boex's research was limited, it provided a baseline estimate of the added costs of residency training and suggested that operating primary care residency programs were in fact more expensive, thereby possibly decreasing the likelihood that hospitals would initiate and maintain them. This is especially relevant if adding new residency programs to smaller communities might increase the number of physicians available in rural and remote areas, thus, increasing access to health care services.

Emilie Osborn researched factors that influenced the 1992 graduates of University of California-San Francisco School of Medicine to select either primary care or non-primary care medical specialties. She found three factors that significantly influenced the students' residency specialty choices: future income, opportunities to work with new technology, and faculty advisors. Two factors, future income and working with new technologies influenced students to select non-primary care medical specialties, while faculty advisors were influential to students who chose primary care specialties. Osborn concluded that medical school leaders and administrators could increase the numbers of students entering the primary care fields through expanded student/faculty mentorship programs and providing students with opportunities observe and participate in primary care (Osborn, 1993, p. 574). Osborn also found that students' specialty decisions were influenced by their level of educational debt. She noted that students with high levels of debt were more likely to select a non-primary care specialty. Additionally, students considered the length of the residency and the perceived professional prestige in evaluating and selecting their specialty choices (p.574).

Sonya Lawson and colleagues studied student characteristics in an effort to determine measures that predict physicians selecting primary care (Lawson, Hoban, Mazmanian , 2004, p.S37). In their study of Virginia Commonwealth University School of Medicine graduates in 1998 through 2000, they reviewed student demographic characteristics, student experiences in medical school, and residency experiences after medical school. They found that gender was the only demographic factor that predicted residency selection. Females in their study were four times as likely as males to select pediatrics residency programs.

Studies of Residents Training and Physician Distribution

Many studies have focused on the physician distribution and residency training. Based on these studies, programs have been initiated at the state and federal levels in an effort to influence physician distribution. For example, the Texas Legislature initiated an effort in the late 1970s to encourage increased production of family physicians through funding of a statewide effort to support the development and maintenance of family practice residency programs. This approach was thought to influence physician distribution to the rural areas of the state (Denton, Cobb & Webb, 1989, p.400). Legislators and physician leadership believed that providing funding to establish new family practice residency programs in smaller more rural communities would result in greater numbers of these physicians remaining to practice in the area upon completion of residency training. David Denton and his colleagues evaluated the policy and concurred that state support for family practice residency programs, "had the desired effect of moving large numbers of family physicians out into the smaller communities that have suffered most from the increasing concentration of physicians in larger metropolitan areas." (1989, p.404). They concluded that the location of residency programs was related practice location (1989, p.400).

Researchers Tim Henderson, Carrie Farmer and Suzanne Szwarc built on the idea that residency training influenced practice location. Their research looked at all the states and explored whether the states served as markets for these physicians (2003, p.17-23). Their report, issued by the National Conference of State Legislatures (NCSL) in 2003, confirmed that states vary widely in their ability to train and educate physicians who remain and practice within their borders (Henderson, et al., 2003). Their research analyzed data collected by the American Medical Association, which maintains a national database that contains current and historical data related to the nation's physician workforce. Their study data elements were limited, so that actual links between individual medical school attendance and residency training were not made. Henderson, et al., hypothesized that because states support medical schools and the education of physicians, this might influence where physicians ultimately practice. Multiple sources of national data were analyzed to address their question. Henderson, et al, found wide variations between states in the proportion of physicians who practiced in the state in which training was completed. For example, of the current physicians providing care in Nebraska, 60 percent graduated from a Nebraska medical school, while only seven percent of physicians practicing in New Hampshire graduated from an in-state school. This study also found that states that educated greater numbers of under-represented minorities (i.e., African American, Hispanic, and Native American Indian) were more likely to retain greater numbers of physicians who practice in rural areas.

Anderson, Bergeron, and Crouse (1994) studied how rural family physicians choose their practice locations. They concluded that colleagues were the strongest influencing factor regarding whether a physician chose a particular rural community. Also important were geographic location, recreational activities, call schedule, and opportunities for spouse and children. This study suggests that the greatest barrier to health care for a small community is inadequate physician supply, specifically the inadequate supply of family physicians. The authors found that for the physicians studied, the majority began looking for practice opportunities by the second year of their three-year residency training program. Additionally, they found that salary alone did not play a significant role in the decision to locate in a rural community. Anderson, et al., also found that information about rural practice opportunities was difficult for residents to obtain. They suggested that more physicians would be attracted to rural communities if available opportunities were known (Anderson, Bergeron, & Crouse, 1994).

In 1992 Blondell, Mason, Looney, and James traced the outcomes of the University of Louisville Family Practice Residency Program, which opened in 1972, as part of the national push to encourage and support the training of family physicians. Blondell, et al., found that of the 100 physicians completing residency training since the program's inception, 68 were currently practicing in Kentucky, with 31 of those providing care to rural or medically-underserved areas of the state. They also found that minority physicians located in urban underserved areas to a higher degree than did their white counterparts. The study found no significant relationship between gender and location in a rural community (Blondell, Mason, Looney, & James, 1993).

Bowman and Penrod found that minorities and females were less likely to practice in rural areas (1998). They found that non-military family practice residency programs were graduating approximately 600 residents annually. They reviewed program characteristics thought to influence locating in a rural community. They found that rural training experiences were influential in resident practice decisions. They found that programs that graduated more rural physicians had more required rural and obstetrical training months, had full or partial rural missions, were located in more rural states, emphasized procedural training, and had program directors who had an interest in rural practice. They also found that programs with more minorities and women graduated fewer rural physicians. They found that the population of the local community in which the residency program was located, the number of faculty with experience practicing in rural areas, and whether the hospital was publicly or privately funded had no relationship to future practice in rural communities. Bowman, et al., concluded that predictable factors could be identified and that if policies were implemented on a larger scale, the physician maldistribution in rural communities could be relieved.

Brooks, Walsh, Mardon, Lewis, and Clawson reviewed published studies to evaluate recruitment and retention factors associated with physicians locating in rural communities. They concluded that factors positively associated with rural practice could be categorized as either occurring prior to entrance to medical school or during medical school. Pre-medical school elements positively associated with rural practice included those they defined as “nature” while those factors identified as influential in medical school were identified as “nurture”(Brooks, et al., p.790-794). The factors associated with the “nature” of the individual included rural upbringing, while the “nurture” factor of exposure to family medicine encouraged medical students to select primary care specialties.. They also found that having practice opportunities available during medical school and residency training in rural communities was linked to rural practice (Brooks, et al., 2000, p.792).

Cregler, McGanny, Roman, and Kagan found in 1997, that a medical student’s ethnicity was an important factor in practicing in an inner-city underserved area. Their study was limited to graduates from the City University of New York. However, they recommended that their approach be used elsewhere to validate their methodology, which they anticipated would help educators and policymakers better understand the career paths of physicians. Their findings indicated that gender did not play a role in practice location. (Cregler, McGanney, Roman, & Kagan, 1997).

In 1997, Cullen, Hart, Whitcomb, and Rosenblatt found that many participants in the National Health Service Corps, a federal program implemented to affect physician distribution on a national scale, did not remain and practice in the community in which they were placed and obligated to serve for a set number of years. The authors encouraged the continuation of the National Health Service Corps and emphasized the finding that physicians who reported strong commitment to rural practice and completed a family practice residency program would be more likely to stay in the nation's rural communities (Cullen, Hart, Whitcome & Rosenblatt, 1997).

In 2000, Bacon, Baden, and Coccodrilli reviewed national Area Health Education Center (AHEC) data and primary care residency training and found that family physicians were more likely to practice in the state where residency training occurred (Bacon, Baden & Coccodrilli, 2000). The study focused on family physicians who participated in AHEC-sponsored family practice residency programs in Arkansas, North Carolina, and South Carolina. Approximately 2,000 family physicians completed residency training at AHEC sites in these states between 1976 and 1999. Of those residents, 61 percent practiced in the state where they trained. However, there was considerable variation by state. In Arkansas, 70 percent of residents remained in-state to practice, while in South Carolina, only 54 percent did, suggesting that other factors may have influenced practice location.

In 1997, Elam, Mitzi, Johnson, and Rosenbaum compared the specialty choices of early-decision medical graduates, (students offered admission to medical school early in their senior year of college) to those of regular admission graduates to explore differences in practice locations. They found that students admitted early to medical school were more likely to be in-state residents and most often graduated from an in-state college or university. These medical students were more likely to remain in-state for residency training, and were more likely to practice medicine in-state. Based on their findings, they encouraged medical schools to work with undergraduate institutions to select medical students who have a greater likelihood of staying in the state to practice following residency completion (Elam, Mitzi, Johnson, & Rosenbaum, 1997).

In a previous study, Elam, Johnson, and Rosenbaum studied factors that predicted which medical students would stay in Kentucky and practice in rural communities (1994, p.446-450). Their study was limited to graduates of the University of Kentucky, College of Medicine from 1974 through 1985, and included 1,243 medical students for whom information on their residency program participation was available. They found a statistically significant percentage of medical students remained in-state to practice and many returned to their local communities or in areas close to the locations they grew up. They found that location of the residency program was the greatest predictor of residency location. They also found that other demographic factors, while limited, were helpful in predicting whether or not physicians would remain in Kentucky to practice. Personal demographic characteristics including gender, undergraduate institution of graduation, and residence at the time of admission to medical school accounted for eight percent of the variance in physician practice location (Elam, Mitzi, & Rosenbaum, 1996).

Much literature suggests that physician practice location is influenced by community affiliation and location of upbringing; that is to say, if a physician grows up in a rural or underserved (primarily minority) community, he or she will exhibit a greater likelihood of returning to such a community to practice. Hughes, et.al., looked at a cohort of 214 graduates of the University of California, San Francisco-Fresno Family Practice Residency Program from its establishment in 1970 through 2000 to identify whether high school graduation, a proxy for location of upbringing, was a predictor of practice location. They found a statistically significant relationship between graduation from a rural high school and practice in a rural community, with 12 of 38 physicians who graduated from a rural high school practicing in a rural area. They also found that if a family practice resident graduated from a high school with a high percent of minority students, the physician was more likely to practice in a community with a large minority population. However, the study did not find a statistically significant relationship between location of high school graduation and areas designated by the federal government as “medically underserved areas”(MUAs) (Hughes, et al, 2005).

Summary

This review of the literature details the history and studies related to physician workforce. Additionally, the emergence, development, and current state of primary care and other medical specialties were presented. Previous studies of physician distribution were summarized to serve as a context for this study. Various methods have been employed to measure and predict the physician workforce as it relates to the needs of the U.S. population. Additionally, many approaches have been tried to influence change in physician demographics and geographic distribution, with varying success. In the early 1900s the medical profession began to monitor the workforce actively in an effort to elevate professional status and provide appropriately trained physicians for the nation.

By the mid-1990s primary care physicians were viewed by many researchers and policy makers as a solution to health care access and cost containment problems. This led to implementation of federal and state policies initiated to produce an adequate supply of physicians. Because primary care physicians serve as a patient's initial point of contact in an increasingly specialized health care system, increasing their numbers is thought by many as being important in ensuring that the U.S. has a physician workforce that is responsive to the needs of its citizenry. National calls to increase the numbers of primary care physicians have been echoed by state leaders, often prompted by physician professional associations and state legislatures. Many of these efforts have resulted in support for policies, programs, and funding to encourage and promote the education and training of primary care primary physicians.

Whether the policies implemented as a result have produced more of the physicians that most care for the patient population of each state has not been studied independently. However, the rise of primary care has not resulted in the reduction of health care costs, and the results related to access to health care services are mixed. Health care costs are increasing and the numbers of residents in training are rising. Recent calls for increased U.S. medical school enrollments will likely result in more physicians being trained to care for the population.

The literature related to physician workforce, geographic distribution, and the characteristics related to specific practice location is substantial. Federal and state policy makers, as well as medical school researchers and administrators, have studied and reviewed multiple layers of information concerning graduate medical education. The complexity and length of the medical and graduate medical education pipeline make it difficult to develop a realistic view of the relationships between education, residency training, and practice location. Often, this results in a widespread acceptance of physician behavior based on snapshot studies with incomplete datasets rather than serious observation of the entire physician education landscape. This has the potential to lead toward the implementation of policies directed at altering or managing predicted physician education and practice patterns that do not materialize.

The historical evolution of U.S. medicine has established specialization as the norm. However, the drive toward specialization has had another effect, the decline in the availability of physicians in rural communities. There is a persistent shortage of primary care physicians, though many programs and policies have been implemented to ameliorate the shortage. Many researchers have studied physician specialization as it relates to physician distribution. Studies have been performed and policies have been developed, but the problem of too few physicians to treat populations located in rural and remote areas of the country continues.

While the U.S. physician workforce has been studied extensively, many questions remain. The most persistent perhaps is how to best affect physician distribution in a system set up to train highly specialized physicians that remain in urban areas to practice. Many have studied the factors thought to influence primary care selection and practice location. This dissertation focuses on one state and its primary care physician population. Understanding where primary care residency programs are located in Texas and identifying which residency programs produce physicians who stay in the state and which medical specialties produce physicians willing to practice in rural areas is explored through the data collected over several years. The specific methodology used to complete this study is described in the next Chapter.

CHAPTER 3

Research Method

This study applied a quantitative descriptive design to explore demographic information, including education experience and training of primary care physicians, to better understand the population studied. The population studied was Texas primary care residents who completed a three-to-four year primary care residency program in Texas during the period 1996 through 2001.

Study Design

This study was designed to evaluate the likelihood that members of this population remain in Texas to practice following the completion of their training. The data were then analyzed to assess the likelihood of the physicians who remained in Texas practicing in a federally-designated whole county Health Professional Shortage Area (HPSA). The whole county HPSA designation was used as a proxy for rural and underserved areas of the state.

Descriptive design was employed to measure the existing population as it was; no attempt was made to change behaviors or conditions, only to monitor the population through observation as provided by the survey data. This dissertation was designed to provide an assessment of Texas primary care residency training and quantify the effect of residency training on practice location.

Data collection involved two state agencies, the Texas Higher Education Coordinating Board and the Texas Medical Board (TMB). Demographic data from the

Coordinating Board were merged with licensure data from the TMB in March 2005. This resulted in a comprehensive data set of primary care resident physicians who had completed residency training and obtained a Texas medical license. Additional data elements were added using data provided by other state agencies. Descriptions of these data elements are provided in the survey description section that follows.

Coordinating Board Survey Data

This study analyzed survey data collected by the Coordinating Board through the Primary Care Residency Tracking Survey (Appendix B). The survey instrument was developed by Coordinating Board staff to monitor residency programs receiving state funding under the Graduate Medical Education program, which was established by the Texas Legislature in 1995. The Tracking Survey developed from a previous Coordinating Board survey instrument that assessed and monitored Family Practice Residency Programs. The earlier survey had been in use since the early 1980s and was used to track the production of family physicians by residency program and to monitor changes in the numbers of family physicians trained by each program.

Because the Legislature expanded General Revenue funding to include all primary care residency programs through the establishment of the Graduate Medical Education program, a trusteed funding program housed at the Coordinating Board, the Tracking Survey was revised in 1995 to collect information from all primary care programs--those in family practice, internal medicine, pediatrics, and obstetrics/gynecology. Beginning in summer 1996 each primary care residency program was contacted and asked to complete the Coordinating Board's Tracking Survey. The Legislature ensured that collection of the information requested by the Coordinating Board would be complete, as submission of data was a requirement for funding under the program. Data collected using the Tracking Survey from 1996 through 2001 was analyzed for this dissertation.

Tracking Surveys were sent to all primary care residency program directors and were most commonly completed by the residency program coordinators. The resident physicians, themselves, were not responsible for completing the surveys. However, because personal information was released, the program administrators notified the residents about the survey. The submission date of the Tracking Survey coincided with the end of the residency programs' academic year, which runs July 1 through June 30.

The Tracking Survey instrument consisted of two parts: aggregated program information and individual resident information. The aggregated program information consisted of a single page overview of the program and provided each program with a unique identifying number. This identifying number is made up of a program code (postal zip code) and a code identifying specialty type (i.e. family practice, internal medicine, obstetrics/gynecology, or pediatrics). Reported in this section were total numbers of residents completing training for the year. This was used to ensure that survey data were collected for the entire primary care residency training population.

The second part of the Tracking Survey provided individual resident information. A data sheet was completed for each resident completing the program. The following data items were collected: physician's last name, first name, date of birth, gender, U.S.

citizenship, ethnicity, medical school of graduation, degree, date of medical school graduation, social security number, and Texas medical license or permit number. These data were used in this study. The Tracking Survey included a question about future practice intentions and included: intended practice setting, activity, and address. However, data related to physicians' future intentions were incomplete or unknown; therefore, the information was not used in this dissertation.

Prior to entry into the study data base, the Tracking Survey data on the individual and program demographics were reviewed for accuracy and completeness. Initial survey submissions were evaluated for discrepancies, such as incomplete reporting on individual residents or differences between the number of resident data sheets and the total number of completers reported by a program. Coordinating Board staff contacted the residency program coordinators to resolve all data discrepancies. Because programs did not have addresses of residents following completion of their program, no attempt was made to complete the intended practice location. Irregularities were identified in names, social security numbers, and medical schools of graduation. These discrepancies were corrected as well.

Data were collected from seventy-seven primary care residency programs for the years 1996 through 2001. Of that total, 32 were family practice programs, 15 were internal medicine programs, 11 were pediatrics programs, and 19 were obstetrics/gynecology programs. Individual data were collected on 4,250 physicians who completed their residency training during those six years. Because survey data were collected on all primary care residency programs and all resident physicians who successfully completed a primary care residency training program in Texas during the study period, no further sampling was done.

Matching to the TMB Licensure Data

To determine whether resident physicians held active Texas medical licenses, Coordinating Board survey data were matched to the Texas Medical Board (TMB) licensure data. The Coordinating Board survey data were sent to the TMB and TMB staff performed an electronic match of records. The match was based on social security number and TMB's license number. All residency completers, including IMGs, had a social security number and either a temporary or permanent license number issued by the TMB. These two identifiers provided a high level of assurance in the accuracy of the resulting matched data set.

The TMB returned a single data set including all original survey data, to which they added the Texas practice address of all identified residents holding an active Texas medical license, as of March 2005. The TMB defines "active practice of medicine" as a licensed Texas physician practicing medicine full-time, at more than 20 hours per week (TMB, Rule §163.11 Active Practice of Medicine, accessed on-line at www.tmb.state.tx.us). Of the 4,250 records in the Coordinating Board survey data, 3,469 (81.6%) were matched to TMB licensure data, indicating these residents had maintained active Texas medical licenses as of that date. However, not all of the resident completers who were matched with an active Texas medical license currently practice medicine in Texas. Some physicians maintain an active Texas medical license, but practice in another state. It is known that physicians who were not matched (18.4% of the initial Coordinating Board data set) were not legally practicing medicine in Texas at that time. These data provide a comprehensive, time-specific snapshot of primary care physicians and, for those licensed in Texas, their practice locations.

Data Cleaning

To ensure data accuracy, all 114,750 individual data items were confirmed manually against the original paper survey forms submitted by the residency programs and the on-line data base of the TMB. Errors in data entry were identified and corrected. As part of this process, data elements were standardized to allow for analysis. For example, “UTHSC-SA,” “University of Texas San Antonio medical school,” “UT Health Science Center San Antonio,” and “The University of Texas Health Science Center at San Antonio” were standardized to “UTHSC San Antonio.”

Data Added -- Whole County Health Professional Shortage Areas

The primary care whole county HPSA designation results from a state-federal identification process which designates geographic locations with limited numbers of primary care physicians. Within these counties, there are few licensed and available primary care physicians to provide health care services to the local population. Designation of counties as HPSAs indicates that the health care needs of the county are not adequately addressed. As such, the whole county HPSA designation is used as a designation for underserved areas and/or rural areas. Of the 254 counties in Texas, 129 were designated in 2005 as whole county HPSAs; of these, nine counties were proposed for withdrawal; however because withdrawal had not occurred at time of the analysis, they were included in this designation in this study.

Variables Defined and Coded

The following categorical variables were coded to allow for data analysis:

Active Texas Practice – as reflected in the TMB data, the resident physician was actively practicing in Texas; i.e. he/she was a current holder of a Texas medical license and identified a practice location by address in Texas;

Gender – resident physicians were coded 0 for male and 1 for female;

Ethnicity – resident physicians were coded as 1-White, 2-Black, 3-Hispanic, 4-Asian, 5-Native American Indian;

Medical School Location – the resident physician held a medical degree from a medical school located as follows: 1- in Texas, 2- in some other state (non-Texas, non-IMG), or 3- from a medical school in a foreign country (non-Texas, non-US);

Residency Program Located in a Medical School – the residency program was physically located at medical school site as follows: 1 – in a Texas Medical School or 2- not in a Texas Medical School;

Residency Program Location Community Size – coded as being in either a large metro area or a smaller community. The large metro designations were based on 2000 Bureau of the Census data and included the following locations: Austin, El Paso, Dallas, Fort Worth, Galveston/Baytown (due to proximity to Houston), Houston, and San

Antonio. Smaller communities included Corpus Christi, Amarillo, Lubbock, Temple, Odessa, Port Arthur, Tyler, Texarkana, Waco, McAllen, Wichita Falls, Bryan, Groves, and Harlingen. The large cities all had populations in excess of 500,000 and most had a significant medical school presence. The cities coded as smaller communities had approximately half the population in 2000 than did the large cities.

Texas Public Higher Education Bachelor's degree – the physician had received a baccalaureate degree from a Texas public institution of higher education, as identified by Coordinating Board data. Data were only available for this group for those who had graduated with a bachelor's degree after 1991. A subset of the "Comprehensive Data Set" was created that excluded all residents who had received a medical degree prior to 1995, as they likely would have received a bachelor's degree prior to 1991. This required the elimination of 901 cases.

Practice in a Texas primary care whole county Health Professional Shortage Area (HPSA) – Indicating that the physician's TMB practice address was within a whole county HPSA, as identified in January 2005.

Summary of Design

Data collection took place from 1996 through 2001 using a survey instrument developed by the Coordinating Board. Coordinating Board staff worked with the Texas Medical Board to develop a data set of primary care residency completers, representing a population of physicians in primary care medicine in Texas. Data review and cleaning were conducted and ensured data completeness and accuracy.

Analysis of Data

The comprehensive data set that resulted from the merging of the Coordinating Board survey data, matched TMB licensure data, and coded variables (n=4,250) was used to evaluate those personal characteristics related to staying and practicing in Texas following residency training. This data set included data on all residency completers for the years 1996 through 2001. For the remainder of this dissertation, this data set is referred to as the "Comprehensive Data Set."

A subset of the "Comprehensive Data Set" was created that included only those physicians currently practicing medicine in Texas (n=2,669). This data set was used to evaluate the personal characteristics related to practice in whole county HPSAs. Creation of this reduced data set was necessary because physicians who were not practicing in Texas, whether licensed in Texas or not, could not be coded according to practice location in a whole county HPSA. For the remainder of this dissertation, this data set is referred to as the "In Texas Data Set."

An additional subset of the "Comprehensive Data Set" was created to explore the relationship between obtaining a bachelor's degree in Texas and remaining in Texas to practice. This data set (n=3,349) included all resident physicians who, based on age in March 2005 could have potentially graduated from college and been included in the limited data available from the Texas Higher Education Coordinating Board at the time. This data set is called "Potential Texas Undergraduates."

Missing data were eliminated using the case wise approach from each of the three data sets to run logistic regression analysis. For example, because only four residents identified Native American or Alaskan as their ethnic origin, these cases were merged with the set identified as Asian. Of the Comprehensive Data set of 4,250, there were 39 cases removed from the analysis due to incomplete data. Of that group, 33 had not reported ethnicity and seven had not reported gender, two of the independent variables analyzed. One case reported neither of these elements. Of the “In-Texas Data Set” of 2,669, there were 16 cases removed from the analysis due to incomplete data. Of the “Potential Texas Undergraduates Data Set” 901 were eliminated, based on date of medical school graduation.

Data Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 15.0 and ArcGIS, ArcView version 9.0, geographical mapping software. The following analyses were conducted: frequency distribution tables, chi-square, logistical regression, and geographical depictions.

To address the research question regarding which primary care residency programs produce the greatest proportion of physicians that practice in Texas, frequency distributions were developed. Frequency distributions were prepared for each residency program showing the production of primary care residents by year, gender, ethnicity, location of medical school, location of baccalaureate school, and residency type. Frequency distributions were also prepared showing the number of residents practicing in Texas and in Texas whole county HPSAs (See Appendix C for the list of HPSAs).

ArcGIS, ArcView mapping software was used to provide a visual depiction of the geographic location of the residency programs. This software was also used to provide a geographic view of residency programs to indicate their proximity to whole county HPSAs.

Chi-Square statistics were calculated to determine if residency type, medical school location, ethnicity, gender, residency location in a medical school, and residency location community size were related to practice in Texas. Chi-Square statistics were also calculated to determine if these same variables were related to practice in Texas whole county HPSAs.

Logistic regression tests were conducted to construct a predictive model to further explore the influence of the independent variables and practicing in Texas and practicing in a Texas whole county HPSA. This approach allowed for analysis of independent variables and an assessment of the predictive power. This approach also provided a measure that allows for an understanding of the various primary care specialties using the same demographic criteria. The following predictor variables were used: medical school of graduation (Texas medical graduate, US medical graduate or International Medical Graduate), Type of degree (MD or DO), ethnicity, gender, residency program location, residency located in a medical school, and residency specialty type.

Logistical regression allows comparison of a categorical dichotomous dependent variable to predict membership in another group. In this study the likelihood of a resident remaining in Texas and the likelihood he/she would practice in a rural area (whole-county HPSA) were the two dependent variables analyzed. In order to conduct the binary logistic regression analysis, a preliminary multiple regression was conducted to examine multicollinearity. Tolerance levels were considered acceptable if they were greater than .7 and Variance Inflation Factor levels were considered acceptable if they were less than 2. The Mahalanobis distance was calculated to identify outliers. Logistic regression analysis was run using the enter method. Because logistic regression requires no assumptions about the distributions of the independent (predictor variables), the method provides understanding of the variables using odds-ratios. This allows for an estimate of the probabilities of occurrences in similar populations. This method was used to estimate the probability of a resident physician remaining in Texas and the probability of resident physicians who were practicing in Texas to practice in a whole county HPSA.

Summary of Analysis

This study merged two data sets from two Texas state agencies resulting in a comprehensive data set describing primary care residents who completed training in Texas from 1996 through 2001. Additional data items were added to the Comprehensive Data Set to explore the research questions and the hypotheses presented in Chapter 1. This allowed for analysis of Texas primary care physician practice patterns, based on individual resident characteristics and residency program location and type. Individual physician characteristics included gender and ethnicity, and type of residency program pursued. Additionally, the study design allowed for the analysis of relationships between residency specialties and location of these medical residency programs, for example if the residency program was located within or adjacent to a medical school or in a less-populated, more remote community. The analysis provided a time-specific overview of the Texas primary care landscape during a growth period for primary care physicians.

Elements unique to residency programs, such as location and specialty type, and individual resident characteristics, such as gender, ethnicity, and medical school, were gathered, evaluated, and analyzed to identify outcomes shared by physicians who remained in Texas. Chapter 4 presents the study's findings.

CHAPTER 4

Results

This chapter presents the results of the data analysis conducted to understand the relationship between residency training in Texas and practice location. Three types of analysis were conducted: frequency distributions, Chi-Square tests, and binary logistic regression. Each analytical method provided insights into the relationship between selected demographic variables and the Texas primary care resident physician population studied.

Frequency distributions were used to show the variations in the residency programs in total numbers of residency completers by year, gender, ethnicity, undergraduate institution of graduation, medical school of graduation, type of degree awarded, residency type, and percent of residents in training by specialty, practicing in Texas, and practicing in Texas counties designated as whole county Health Professional Shortage Areas (HPSA). Chi-Square tests were calculated to determine if predictor variables were related to selected outcomes, specifically whether residency type, medical school location, medical degree, baccalaureate institution location, residency location in a medical school, residency location community, gender, ethnicity, and U.S. citizenship were related to practice in Texas. Chi-Square statistics were also calculated to determine if these same variables were related to practice in Texas whole county HPSAs. Statistically significant Chi-Squares were identified, and for those relationships logistic regression analysis was conducted to estimate the probability of a resident physician remaining in Texas, and the probability of resident physicians practicing in whole county HPSAs.

Frequency Distributions – Demographics of Study Population

Data used in this study were collected from all 77 primary care residency programs in operation during the study period. These data were collected annually by the Coordinating Board using the Primary Care Residency Tracking Survey beginning with residency completers in June 1996 and continuing through June 2001. As shown in Table 4.1. a total of 4,250 primary care residents completed their training in Texas during that six year period. The average per year was 708. More residents finished their training in 1998 and 1999. This may have been a result of increased national interest in primary care in the early 1990s due to the role of primary care physicians as "gate keepers" for medicine under managed care.

Table 4.1. *Primary Care Residency Completion by Year*

Year	Residents	Percent of Total
1996	636	15.0%
1997	715	16.8%
1998	757	17.8%
1999	760	17.9%
2000	719	16.9%
2001	663	15.6%
Total	4,250	100.00%

Because women are entering the medical profession in greater numbers, the data were analyzed by gender. Women have just begun to reach parity with men in medical school attendance. In 2003 and 2004, there were more women applicants to U.S. MD-granting institutions than men (Association of American Medical Colleges, 2006, accessed on-line at www.aamc.org). It will be several years before women reach parity in the practice setting, due to rates of retirement and existing physician demographics. Gender equality was not reflected in the resident population studied; as shown in Table 4.2. below, males outnumbered females by almost 13 percent.

Table 4.2. *Gender of the Study Population*

	Residents	Percent of Total
Female	1,849	43.5%
Male	2,393	56.3%
Total	4,242	99.8%

Note: 8 physicians did not report gender.

In addition to gender equity, race and ethnicity were also analyzed. Table 4.3. shows that neither the Texas primary care physician population, nor the practicing Texas physician population reflects the ethnic diversity of the general population of the state. The 2000 general Texas population census data was used, as it best reflected the population during the study period. Ethnic minority populations have long been underrepresented in medicine, except for Asians, who are over-represented in the physician population as compared to the general Texas population. White resident physicians made up more than half of all the primary care residents trained during the study period; however at 56.4 percent, this group was 11 percentage points lower than the practicing White Texas physician population at 67.4 percent. Hispanics and Blacks were each underrepresented as compared to their proportions in the Texas general population, but these residents reflected greater percentages when compared to the their ethnic counterparts in the Texas practicing physician population. Notably, the primary care resident population reflects greater ethnic diversity than does the practicing Texas physician population. Asian physician residents at 23.2 percent of the study population were almost 8 percentage points higher than the proportion of Asian practicing physicians at 15.5 percent.

Table 4.3. *Ethnicity*

	Primary Care Residents	Percent of Residents	Texas Physicians Active Direct Patient Care (2005)	Texas General Population Census Data (2000)
White	2,396	56.4%	67.4%	53.1%
Black	241	5.7%	4.1%	11.5%
Hispanic	588	13.8%	10.6%	32.0%
Asian	988	23.2%	15.5%	2.7%
Native Am/Pacific Islander	4	.1%	.23%	.7%
Total	4,217	99.2%	97.8%	100.00%

Note: 33 residents did not report ethnicity, representing .8 percent of the total population.
Source: Texas Physicians, Active Direct Patient Care, Texas Medical Board, Reports and Statistics, January 2005, 887 physicians reported unknown ethnicity; U.S. Bureau of the Census.

Of the resident population analyzed, a majority (52%) graduated from a Texas medical school, with the degree doctor of medicine (MD) or doctor of osteopathic (DO) medicine; 28 percent graduated from non-Texas U.S. medical schools; and 19 percent graduated from medical schools outside the U.S. This last group, the IMGs, included both U.S. citizens and non-U.S. citizens who received their medical degrees from foreign medical schools. This distribution is shown in Table 4.4.

Table 4.4. *Residents by Medical School Graduation*

	Residents	Percent
Texas Medical School Graduates	2,230	52.5%
Non-Texas U.S. Medical School Graduates	1,201	28.3%
International Medical School Graduates	817	19.2%
Total	4,248	100%

Note: Medical school graduation was unknown for two residents.

To better understand the resident population studied, the occurrence of obtaining a bachelor's degree from a Texas public institution of higher education was explored. Because Coordinating Board college graduation data were only available for students who graduated in 1991 or after, a subset of the Comprehensive Data Set was created. This subset, "Potential Texas Undergraduates," described in Chapter 3, removed 901 residents from the "Comprehensive Data Set," based on their age at the time of residency completion, which suggested they graduated from college prior to 1991. Based on this approach, 3,349 of the initial 4,250 residents in the study population were identified as potentially graduating from a Texas public college or university on or after 1991, while the remaining 901 residents were removed, as they would have graduated prior to 1991.

The Coordinating Board graduation data were matched to the "Potential Texas Undergraduates" data set using social security numbers of the primary care residents.

The result of this match provided a subset of residents who were identified as having graduated from a Texas public college or university on or after 1991. Using the "Potential Texas Undergraduates Data Set" of 3,349 residents, frequency distributions were compiled to assess the number of resident physicians who had completed their undergraduate education in Texas. Table 4.5 shows that a majority (72%) of this subset of resident physicians did not receive a Bachelor Degree from a Texas public institution of higher education. There was no further exploration of the population to understand where the others completed their undergraduate education. Physicians who did not obtain a bachelor's degree from a public Texas higher education institution may have grown up in Texas, graduated from a private or public Texas high school, or graduated from a Texas private institution of higher education or an out-of-state higher education institution. Further exploration of these data elements would provide greater depth and insight into the Texas medical education pipeline.

Table 4.5. *Received a Bachelor's Degree from a Texas Public Higher Education Institution*

	Residents	Percent
Texas public institution Bachelor's Degree	939	28%
Non-Texas public institution Bachelor's Degree	2,410	72%
Total	3,349	100%

The four primary care specialties included in this study were also analyzed using frequency distributions. Table 4.6 shows the distribution of physician residents by medical residency specialty type: family practice, internal medicine, pediatrics, and obstetrics/gynecology. Residents in family practice and internal medicine programs comprised 70 percent of the population studied, while obstetrics/gynecology residents represented approximately 12 percent and pediatric residents represented approximately 19 percent.

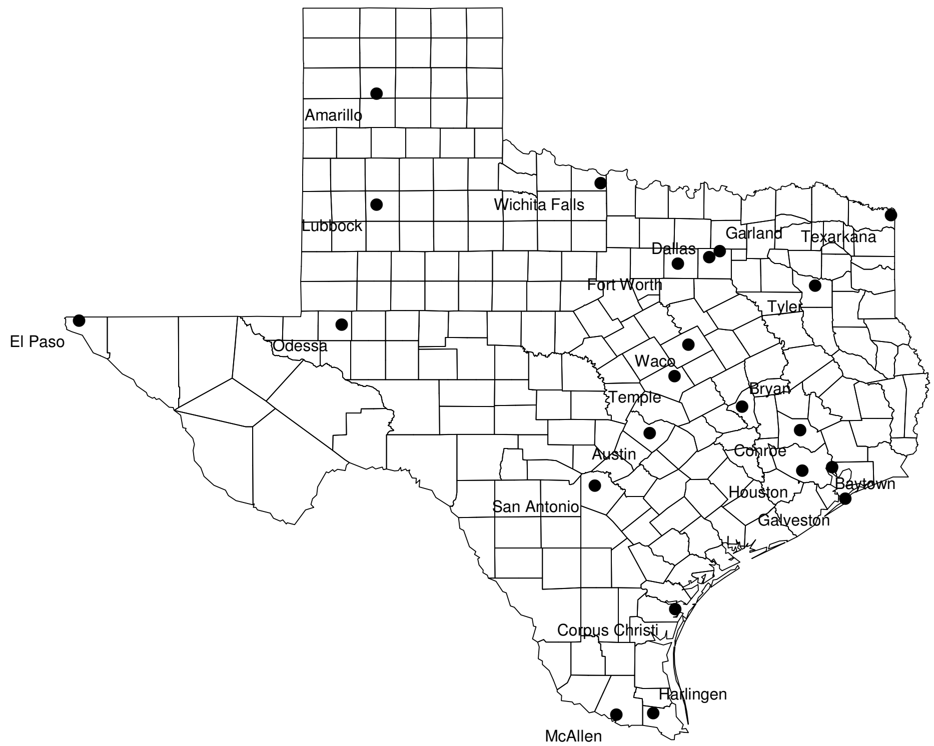
Table 4.6. *Primary Care Residency Type*

	Number of Programs	Residents	Percent
Family Practice	32	1459	34.3%
Internal Medicine	15	1498	35.2%
Obstetrics/Gynecology	19	497	11.7%
Pediatric	11	796	18.7%
Total	77	4,250	100%

Family practice residency programs outnumbered the other specialties and were more broadly distributed throughout the state. Location of residency programs may be influenced by accreditation requirements. Unique to family practice programs is the requirement that they operate a fully-staffed medical clinic that mirrors the actual practice setting. This differs from the other residency specialties in the study, which have accreditation requirements that require residents to treat specified numbers of patients with specific kinds of illnesses or conditions to fulfill their accreditation requirements. Because family practice residents are required to staff and manage a fully-staffed clinic that mirrors the actual practice setting and provide the broadest array of medical care for their patient populations, family physicians are able to train in residency programs located in smaller communities. Often these sites are located at a distance from a medical school. As a result, family practice residency programs are found in more rural and remote areas of the state, such as Tyler, Harlingen, and Amarillo.

Unlike family practice, the other primary care specialties do not have a requirement to operate and maintain a fully-functional medical clinic. These programs were located and maintained in hospitals settings. Internal medicine, obstetrics/gynecology, and pediatric residency program accreditation requirements mandate that residents completed specified numbers and types of procedures, which require the patient complement and technologies found in hospitals affiliated with medical schools. Therefore, areas of dense population are required to train residents in these primary care specialties. Figure 4.1 presents a map showing the location of the family practice residency program sites at the time of the study.

Figure 4.1. *Location of Family Practice Residency Programs*



The names of the family practice residency programs, number of residents trained during the study period, and percentages are shown in Table 4.7.

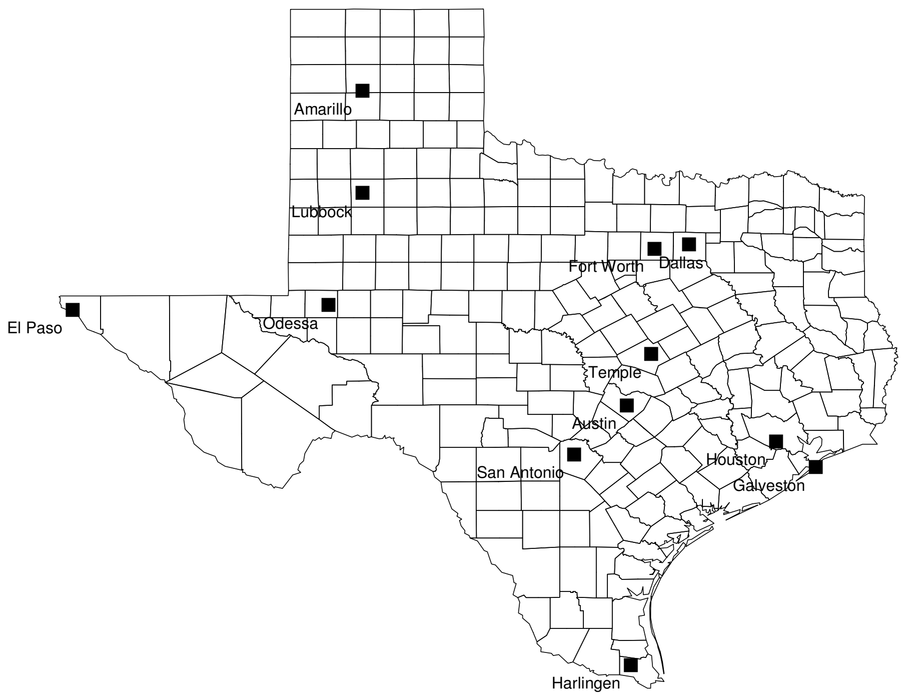
Table 4.7. *Family Practice Residency Programs, Number of Residents and Percent Trained 1996-2001*

		Residents	Percent
1	Bay Area Medical Center FPRP (Corpus Christi)	35	2.4%
2	Baylor College Of Medicine FPRP (Houston)	71	4.9%
3	Baylor Medical Center at Garland FPRP	21	1.4%
4	Brazos Valley FPRP (Bryan)	18	1.2%
5	Central Texas Medical Foundation FPRP (Austin)	43	3.0%
6	Conroe (Montgomery Co) FPRP	37	2.6%
7	Corpus Christi Memorial FPRP	62	4.3%
8	Doctor's Hospital FPRP (Groves)	15	1.0%
9	John Peter Smith Hospital FPRP (Fort Worth)	140	9.6%
10	McAllen/UTHSC San Antonio FPRP	31	2.1%
11	McLennan County FPRP (Waco)	71	4.9%
12	Memorial Hospital/UTHSC-Houston FPRP	91	6.3%
13	Methodist Hospitals Of Dallas FPRP	32	2.2%
14	Parkland Memorial Hospital FPRP (Dallas)	11	.8%
15	San Jacinto Methodist Hospital FPRP	43	3.0%
16	Santa Rosa FPRP (San Antonio)	17	1.2%
17	Scott & White/TAMUSHSC FPRP (Temple)	45	3.1%
18	St Paul-UTSW-Dallas FPRP	30	2.1%
19	St. Joseph Hospital FPRP (Houston)	38	2.6%
20	Texarkana-St Michael's Hospital FPRP	37	2.5%
21	TTUHSC Amarillo FPRP	38	2.6%
22	TTUHSC El Paso FPRP	45	3.1%
23	TTUHSC Lubbock FPRP	48	3.3%
24	TTUHSC Odessa FPRP	33	2.3%
25	UNTHSC Fort Worth FPRP	69	4.8%
26	UT Health Center At Tyler FPRP	41	2.8%
27	UTHSC Houston/Hermann LBJ Hospital FPRP	80	5.5%
28	UTHSC San Antonio FPRP	60	4.1%
29	UTMB Galveston FPRP	63	4.3%
30	UTMB St Mary-Port Arthur FPRP	33	2.3%
31	Valley Baptist Medical Center FPRP	16	1.1%
32	Wichita Falls UTSW FPRP	45	3.1%
	Total	1,459	100.0%

The number of internal medicine programs was less than half the number of family practice programs, but more internal medicine residents were trained during the study period. Internal medicine residency programs were located primarily in the large teaching hospitals affiliated with medical schools. Within the highly specialized areas of medicine, internal medicine residency training serves as a stepping stone or prerequisite for more focused medical specialties, such as cardiovascular disease, gastroenterology, and infectious disease. However, completion of an internal medicine residency program also leads to board certification in the primary care specialty of internal medicine. These physicians provide care and treatment to adult populations. Internists focus on the adult and do not see or provide health care for children. This study made no attempt to identify or analyze internal medicine residents who continued their training in other areas or medical specialties. National studies have shown that approximately 60 percent of internal medicine residents pursue additional subspecialty training. There is no reason to believe the internal medicine residents in this study behaved differently.

The Texas internal medicine residency programs included in this study were primarily located in the large metropolitan areas of the state. Dallas had the most (n=5) and produced the most residency completers (n=429). Houston had two large programs, which had 417 completers. Together more than half of Texas internal medicine residency completers in the study were trained in Dallas or Houston. Figure 4.2. shows the location of the internal medicine residency programs.

Figure 4.2. *Location of Internal Medicine Residency Programs*



The internal medicine residency programs, the number of residents trained during this period and their percentages are shown in Table 4.8.

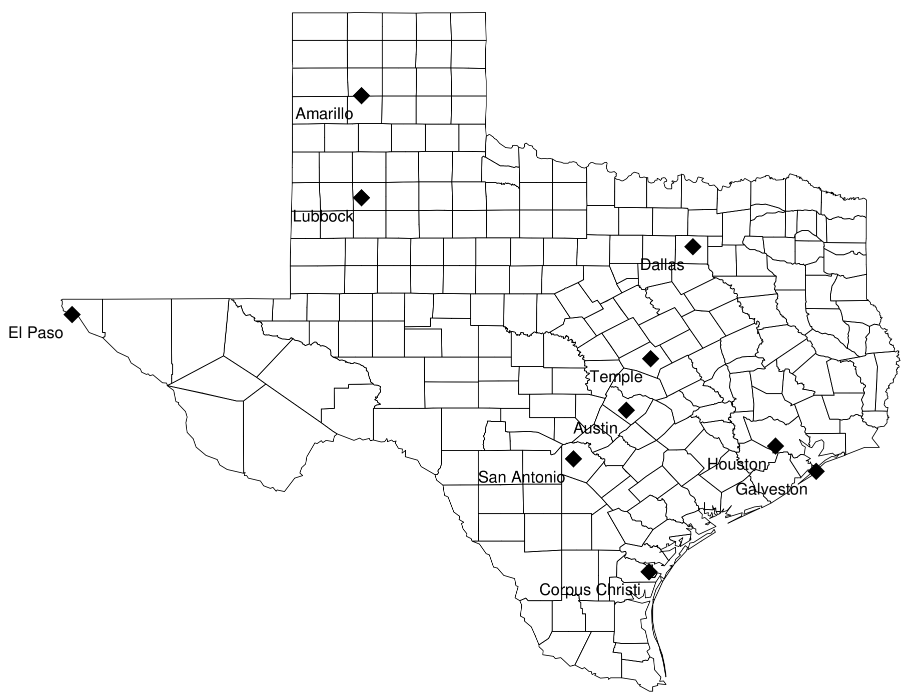
Table 4.8. *Internal Medicine Residency Programs, Number of Residents and Percent trained 1996 through 2001.*

		Residents	Percent
1	Baylor College Of Medicine IMRP (Houston)	241	16.1%
2	Baylor University Medical Center IMRP (Dallas)	62	4.1%
3	Central Texas Medical Foundation IMRP (Austin)	45	3.0%
4	Methodist Hospitals Of Dallas IMRP	32	2.1%
5	Presbyterian Hospital IMRP (Dallas)	50	3.3%
6	Scott & White/TAMUSHSC IMRP (Temple)	61	4.1%
7	St. Paul Medical Center IMRP (Dallas)	36	2.4%
8	TTUHSC Amarillo IMRP	57	3.8%
9	TTUHSC El Paso IMRP	54	3.6%
10	TTUHSC Lubbock IMRP	49	3.3%
11	UNTHSC Fort Worth IMRP	19	1.3%
12	UTHSC Houston/Hermann LBJ Hospital IMRP	176	11.8%
13	UTHSC San Antonio IMRP	157	10.5%
14	UTMB Hospitals IMRP (Galveston)	210	14.0%
15	UTSWMC Parkland Memorial Hospital IMRP (Dallas)	249	16.7%
	Total	1,498	100.0%

Sub-specialization is also a challenge for the primary care specialty of pediatrics. But pediatrics also faces other serious challenges including high rates of uninsured children, high malpractice insurance costs, and relatively low pay. With Texas leading the nation in the number of uninsured children, Texas pediatric residency programs face serious challenges in attracting residents. Nationally, it is thought that approximately 60 percent of pediatricians practice primary care, with the remaining pursuing additional specialized training. As with internal medicine, analysis of sub-specialization in pediatrics was beyond the scope of this study. However, there is no indication that Texas pediatric residency program completers differ from the aggregate national population.

Within the resident physician population studied, only two of the pediatric residency programs were located away from a medical school. These two programs, one located in Austin and the other in Corpus Christi, accounted for 13 percent of the pediatricians trained during the study period. The programs that trained the greatest number of pediatrics residents were located in Houston and Dallas. Figure 4.3. shows the location of the pediatric residency programs.

Figure 4.3. *Location of Pediatric Residency Programs*



The pediatric residency programs, the number of residents trained during this period, and their percentages are shown in Table 4.9.

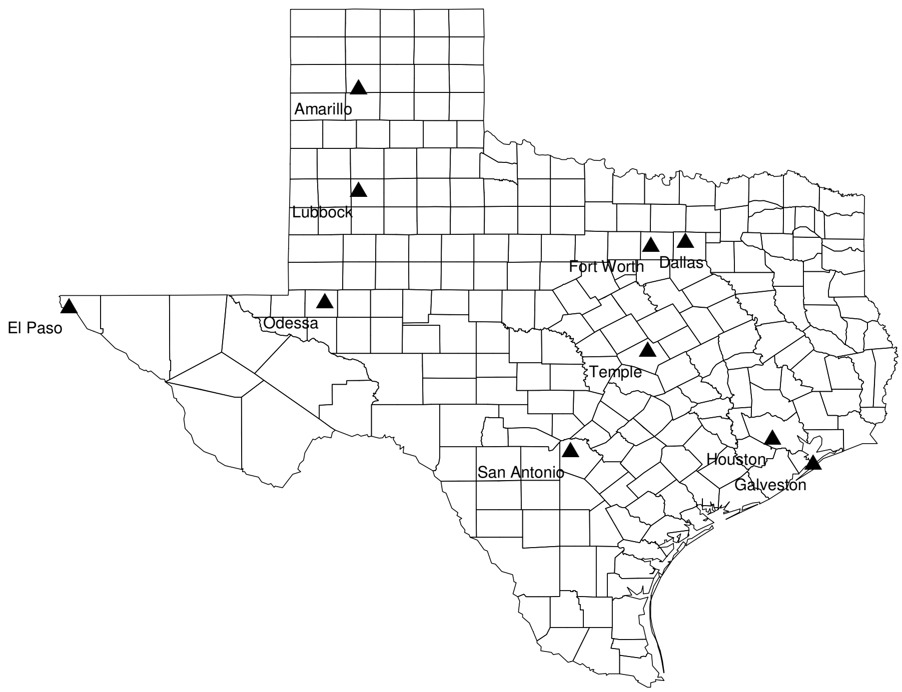
Table 4.9. *Pediatric Residency Programs, Number of Residents and Percent Trained 1996 to 2001*

		Residents	Percent
1	Baylor College of Medicine Pediatric Residency Program (Houston)	216	27.1%
2	Central Texas Medical Found Pediatric Residency Program (Austin)	38	4.8%
3	Driscoll Found Children's Hospital Pediatric Residency Program (Corpus Christi)	61	7.6%
4	Scott & White/TAMUSHSC Pediatric Residency Program (Temple)	14	1.7%
5	TTUHSC Amarillo Pediatric Residency Program	26	3.2%
6	TTUHSC El Paso Pediatric Residency Program	36	4.5%
7	TTUHSC Lubbock Pediatric Residency Program	35	4.4%
8	UTHSC Houston/Hermann LBJ Hospital Pediatric Residency Program	73	9.1%
9	UTHSC San Antonio Pediatric Residency Program	88	11.0%
10	UTMB Hospitals Pediatric Residency Program (Galveston)	76	9.5%
11	UTSWMC/Children's Med Center Pediatric Residency Program (Dallas)	133	16.7%
	Total	796	100.0%

Obstetrics/gynecology residency programs differ in several ways from the other three primary care specialties. The length of training is four years, rather than three for the others. Fewer residency positions are available, so fewer residents are matched. Therefore, these residency positions are more difficult to obtain, as there is greater competition for each position. The patient population is more restricted than those for other primary care residencies, as the focus of the specialty is on women, specifically women's reproductive health. However, often the role of the obstetrician/gynecologist for his or her patient population regularly includes serving as the first point of contact in the health care system, referring patients to other physicians when necessary. Therefore, the duties of obstetricians/gynecologists are inclusive of primary and specialty care. They are required to demonstrate proficiencies in providing surgical procedures (e.g., Cesarean Section) and primary care services. Additionally, their primary focus on women's reproductive systems requires that residency programs have an adequate female population available for care and treatment.

Interestingly, debate in the mid-1990s resulted in female patients having the ability to designate obstetricians/gynecologists as their primary care physicians. Of note and perhaps a contributing factor in the number of physicians entering these residency programs is the reality of malpractice lawsuits. Such litigation has resulted in obstetricians/gynecologists having the highest malpractice insurance rates of the primary care specialties. Figure 4.4 shows the location of the obstetrics/gynecology residency programs in place in Texas during the study period.

Figure 4.4 *Location of Obstetric/Gynecology Residency Programs*



The obstetrics/gynecology residency programs, the number of residents trained during this period and their percentages are shown in Table 4.10.

Table 4.10. *Obstetric/Gynecology Residency Programs, Number of Residents and Percent Trained 1996 through 2001*

		Residents	Percent
1	Baylor College of Medicine Ob/Gyn (Houston)	68	13.6%
2	Baylor University Medical Center Ob/Gyn (Dallas)	23	4.6%
3	John Peter Smith Hospital Ob/Gyn Residency Program (Fort Worth)	18	3.6%
4	Methodist Hospitals Of Dallas Ob/Gyn Residency Program	10	2.0%
5	Scott & White/TAMUSHSC Ob/Gyn Residency Program	30	6.0%
6	St Joseph Hospital Ob/Gyn Residency Program (Houston)	18	3.6%
7	St Paul Medical Center Ob/Gyn Residency Program (Dallas)	10	2.0%
8	Tri City Health Center (Dallas)*	1	0.2%
9	TTUHSC Amarillo Ob/Gyn Residency Program	21	4.2%
10	TTUHSC El Paso Ob/Gyn Residency Program	22	4.4%
11	TTUHSC Lubbock Ob/Gyn Residency Program	17	3.4%
12	TTUHSC Odessa Ob/Gyn Residency Program	12	2.4%
13	UNTHSC-Fort Worth Ob/Gyn Residency Program	8	1.6%
14	UNTHSC-Fort Worth OB/Gyn*	2	0.4%
15	UTHSC Houston/Hermann LBJ Hospital Ob/Gyn Residency	31	6.2%
16	UTHSC Houston/Medical School Ob/Gyn Residency Program	33	6.6%
17	UTHSC San Antonio Ob/Gyn Residency Program	40	8.0%
18	UTMB Hospitals Ob/Gyn Residency Program (Galveston)	50	10.0%
19	UTSWMC/Parkland Ob/Gyn Residency Program (Dallas)	83	16.7%
	Total	497	100.0%

** Programs closed.*

Practice in Texas

An important outcome of primary care residency training is the production of physicians who stay in Texas and provide health care services to the citizens of the state. A majority of physicians who completed residency training in the four primary care specialties during the study period remained to practice in the state. However, 37 percent did not stay in Texas following residency training. Table 4.11 presents the number of residents who completed training in a Texas primary care residency program and as of March 2005 held an active Texas medical license with a practice address in Texas.

Table 4.11. *Primary Care Physician Residents Practicing in Texas*

	Residents	Percent
Practicing in Texas	2,669	62.8%
Not Practicing in Texas	1,581	37.2%
Total	4,250	100.0%

Table 4.12. shows by residency program, the number of residents who completed training, the number actively practicing in Texas, and the percentage of residents who completed and were actively practicing medicine in Texas, as of March 2005. Two programs were removed from the list because they had so few residents complete training during study period. Fifteen of the remaining 75 primary care residency programs had more than 75 percent of their completers actively practicing in Texas. Of these, 14 were family practice residency programs and one was an internal medicine residency program. Corpus Christi Memorial and Parkland Memorial had the highest percent of residents practicing in the state as of March 2005, at 82 percent. Texarkana’s family practice residency program had the lowest percentage of physicians remaining in Texas to practice, only 24 percent. However, since Texarkana is a community that sits in both Texas and Arkansas, it is likely that a similar number of the physicians who trained in this program practice in Arkansas, rather than Texas.

Table 4.12. *Primary Care Resident Physicians in Texas by Program*

Resident Program	Total Residency Completers	Active TX Practice	Percent Practicing in TX
Corpus Christi Memorial FPRP	62	51	82%
Parkland Memorial Hospital FPRP (Dallas)	11	9	82%
UNTHSC Fort Worth FPRP	69	56	81%
Baylor Medical Center at Garland FPRP	21	17	81%
UTHSC San Antonio FPRP	60	48	80%
TTUHSC Lubbock FPRP	48	38	79%
St. Joseph Hospital FPRP	38	30	79%
UNTHSC Fort Worth IMRP	19	15	79%
Methodist Hospitals Of Dallas FPRP	32	25	78%
UT Health Center At Tyler FPRP	41	32	78%
Memorial Hospital/UTHSC-Houston FPRP	91	71	78%
John Peter Smith Hospital FPRP	140	108	77%
Central Texas Medical Foundation FPRP	43	33	77%
Santa Rosa FPRP (San Antonio)	17	13	76%
McLennan County FPRP (Waco)	71	54	76%
Baylor University Medical Center IMRP (Dallas)	62	46	74%
Scott & White/TAMUSHSC Ob/Gyn (Temple)	30	22	73%
Conroe (Montgomery Co) FPRP	37	27	73%
St. Paul Medical Center IMRP	36	26	72%
San Jacinto Methodist Hospital FPRP	43	31	72%
Presbyterian Hospital IMRP (Dallas)	50	35	70%
UTHSC San Antonio Ob/Gyn Residency Program	40	28	70%
UTHSC Houston/Hermann LBJ Hospital FPRP	80	56	70%
Methodist Hospitals Of Dallas Ob/Gyn	10	7	70%
St Paul Medical Center Ob/Gyn Residency	10	7	70%
St Paul-UTSW-Dallas FPRP	30	21	70%
Central Texas Medical Foundation IMRP	45	31	69%
Scott & White/TAMUSHSC IM	61	42	69%
Bay Area Medical Center FPRP	35	24	69%
Driscoll Children's Hosp Ped Residency (Corpus Christi)	61	41	67%
UTHSC Houston/Hermann LBJ Hosp Pediatric Residency	73	49	67%
Doctor’s Hospital FPRP (Groves)	15	10	67%
TTUHSC Odessa FPRP	33	22	67%
Scott & White/TAMUSHSC FPRP (Temple)	45	30	67%
St Joseph Hospital Ob/Gyn Residency Program	18	12	67%
Wichita Falls UTSW FPRP	45	30	67%
UTHSC San Antonio IMRP	157	104	66%
TTUHSC Amarillo FPRP	38	25	66%
Baylor University Medical Center Ob/Gyn (Dallas)	23	15	65%

Resident Program	Total Residency Completers	Active TX Practice	Percent Practicing in TX
UTMB Galveston FPRP	63	41	65%
TTUHSC Lubbock Ob/Gyn Residency Program	17	11	65%
UTSWMC/Children's Med Center Ped Residency Program	133	86	65%
McAllen/UTHSC San Antonio FPRP	31	20	65%
TTUHSC Lubbock IMRP	49	31	63%
TTUHSC Lubbock Pediatric Residency Program	35	22	63%
UNTHSC-Fort Worth Ob/Gyn Residency Program	8	5	63%
Baylor College Of Medicine FPRP	71	44	62%
UTMB Hospitals Pediatric Residency Program	76	47	62%
Brazos Valley FPRP	18	11	61%
Central Texas Medical Found Pediatric Residency Program	38	23	61%
UTHSC San Antonio Pediatric Residency Program	88	53	60%
Methodist Hospitals Of Dallas IMRP	32	19	59%
TTUHSC El Paso Ob/Gyn Residency Program	22	13	59%
UTSWMC/Parkland Ob/Gyn Residency Program	83	49	59%
TTUHSC Odessa Ob/Gyn Residency Program	12	7	58%
UTMB Hospitals Ob/Gyn Residency Program	50	29	58%
UTHSC Houston/Hermann LBJ Hospital IMRP	176	102	58%
TTUHSC Amarillo Pediatric Residency Program	26	15	58%
UTMB St Mary-Port Arthur FPRP	33	19	58%
John Peter Smith Hospital Ob/Gyn Residency Program	18	10	56%
UTHSC Houston/Medical School Ob/Gyn Residency Program	33	18	55%
Baylor College Of Medicine Ob/Gyn Residency Program	68	37	54%
UTMB Hospitals IMRP	210	113	54%
TTUHSC El Paso FPRP	45	24	53%
TTUHSC Amarillo Ob/Gyn Residency Program	21	11	52%
UTSWMC Parkland Memorial Hospital IMRP	249	130	52%
Baylor College Of Medicine IMRP	241	122	51%
Baylor College Of Med Pediatric Residency Program	216	109	50%
Valley Baptist Medical Center FPRP	16	8	50%
TTUHSC El Paso Pediatric Residency Program	36	18	50%
Scott & White/TAMUSHSC Pediatric Residency Program	14	7	50%
UTHSC Houston/Hermann LBJ Hosp Ob/Gyn Residency	31	15	48%
TTUHSC El Paso IMRP	54	25	46%
TTUHSC Amarillo IMRP	57	22	39%
Texarkana-St Michael's Hospital FPRP	37	9	24%
Total	4,247	2,666	

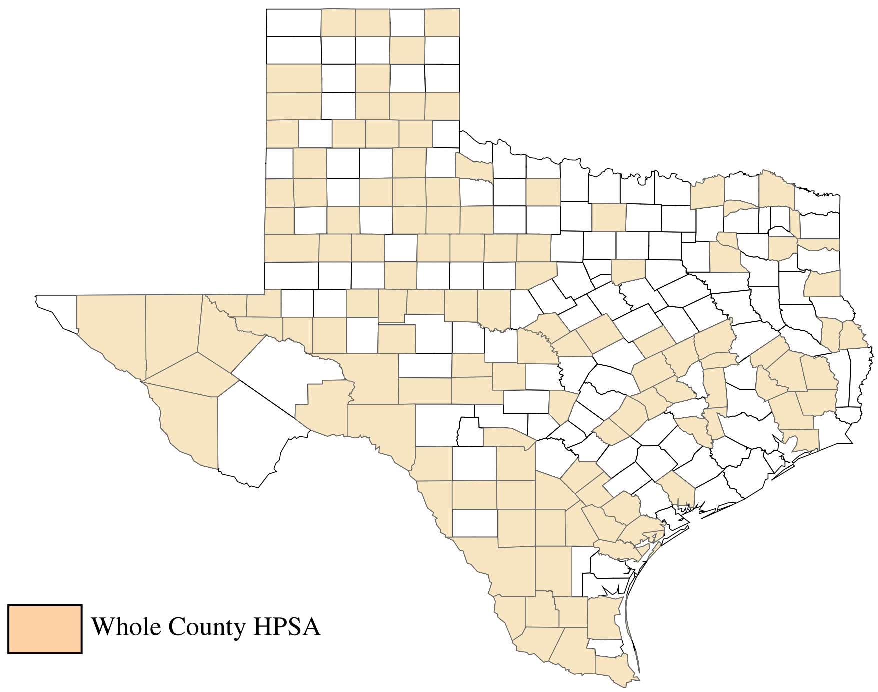
Note: Two programs were removed from the list because they trained so few residents during the period studied. These outliers were, Tri City Health Center OB/Gyn, which trained 1 resident during the period studied and UNTHSC-Fort Worth OB/Gyn program, which trained 2 residents during the period studied. These three residency completers were actively practicing medicine in Texas.

Practice in a Texas Whole County Health Professional Shortage Area

An important outcome of primary care residency training is the production of physicians who practice in underserved areas. While several definitions of "an underserved area" and "rural" exist, the whole county Health Professional Shortage Area (HPSA) designation was used in this study to identify physicians practicing in geographic areas of great need. Texas whole county HPSAs are considered rural by most definitions. These counties have fewer physicians per general population and receive special designation by federal and state governments. Originally, the HPSA designation was used to identify locations with acute shortages of physicians as a mechanism for prioritizing service obligations for National Health Service Corps participants. Physicians who entered the National Health Service Corps were obligated to spend several years practicing in designated HPSAs. Counties identified as HPSAs also qualify for other state federal and state benefits.

Not all counties that can qualify as HPSAs seek the designation. For example, a community population may have limited access to primary care services, but also lack community leadership to apply for the designation. In Figure 4.5. whole county HPSAs in Texas are shown as shaded counties (see Appendix C for list of Whole Count HPSAs).

Figure 4.5. *Whole County Health Professional Shortage Areas*



Source: Texas Department of State Health Services, Whole County HPSAs, 2005

Nationally, physician distribution does not mirror the general population. This is also the case in Texas, where 87 percent of the population resides in the 77 counties identified as metropolitan statistical areas. The remaining 13 percent of Texans reside in the 177 non-metropolitan counties (Rural Policy Research Institute, 2006, p.1). Notably, only 10 percent of Texas primary care physicians were practicing in these counties in 2005 (State Health Plan, 2006, p.42). Some primary care residency programs train residents who locate in more remote areas of the state, such as those identified as whole county HPSAs.

Eleven primary care residency programs had 10 percent or more of their residency completers identified as actively practicing in a whole county Texas HPSA. Six of these programs were in family practice, three were obstetrics/gynecology programs, and two were pediatrics programs. With 55 percent of its residency completers practicing in HPSAs, the McAllen Family Practice Residency Program led the way in the production of resident physicians practicing in whole county HPSAs. Table 4.13. below presents the number of residency completers, number practicing in a whole county HPSA, and the percent practicing in a whole county HPSA by residency program. Because 10 percent of the practicing primary care physician population was identified as practicing in these areas, a bold line highlights the programs that were successful in producing physicians who have selected to practice in whole county HPSAs at a rate of 10 percent or higher.

Table 4.13. *Primary Care Resident Physicians Practicing in a Texas Whole County HPSA*

	Total Residency Completers	Practicing in a Whole County Texas HPSA	Percent Practicing in a Whole Count TX HPSA
McAllen/UTHSC San Antonio FPRP	31	17	55%
Valley Baptist Medical Center FPRP (Harlingen)	16	5	31%
Driscoll Children's Hospital Pediatric Residency Program (Corpus Christi)	61	13	21%
TTUHSC Odessa Ob/Gyn Residency Program	12	2	17%
TTUHSC Amarillo Pediatric Residency Program	26	4	15%
John Peter Smith Hospital FPRP (Fort Worth)	140	16	11%
John Peter Smith Hospital Ob/Gyn Residency Program (Fort Worth)	18	2	11%

	Total Residency Completers	Practicing in a Whole County Texas HPSA	Percent Practicing in a Whole Count TX HPSA
TTUHSC Lubbock FPRP	48	5	10%
UT Health Center At Tyler FPRP	41	4	10%
Corpus Christi Memorial FPRP	62	6	10%
TTUHSC Amarillo Ob/Gyn Residency Program	21	2	10%
TTUHSC El Paso FPRP	45	4	9%
TTUHSC El Paso Pediatric Residency Program	36	3	8%
Central Texas Medical Found Pediatric Residency Program (Austin)	38	3	8%
Scott & White/TAMUSHSC Pediatric Residency Program	14	1	7%
Central Texas Medical Foundation FPRP (Austin)	43	3	7%
Doctor's Hospital FPRP (Groves)	15	1	7%
UTMB Galveston FPRP	63	4	6%
TTUHSC Lubbock IMRP	49	3	6%
Santa Rosa FPRP (San Antonio)	17	1	6%
TTUHSC Lubbock Ob/Gyn Residency Program	17	1	6%
UTHSC San Antonio IMRP	157	9	6%
Bay Area Medical Center FPRP (Corpus Christi)	35	2	6%
TTUHSC El Paso IMRP	54	3	6%
Conroe (Montgomery Co) FPRP	37	2	5%
St. Joseph Hospital FPRP (Houston)	38	2	5%
TTUHSC Amarillo IMRP	57	3	5%
UTMB Hospitals Pediatric Residency Program (Galveston)	76	4	5%
UTHSC San Antonio FPRP	60	3	5%
San Jacinto Methodist Hospital FPRP	43	2	5%
UTHSC San Antonio Pediatric Residency Program	88	4	5%
Memorial Hospital/UTHSC-Houston FPRP	91	4	4%
UNTHSC Fort Worth FPRP	69	3	4%
Presbyterian Hospital IMRP (Dallas)	50	2	4%
UTMB Hospitals Ob/Gyn Residency Program (Galveston)	50	2	4%
Scott & White/TAMUSHSC Ob/Gyn Residency Program (Temple)	30	1	3%
Scott & White/TAMUSHSC IM (Temple)	61	2	3%
Methodist Hospitals Of Dallas FPRP	32	1	3%
TTUHSC Odessa FPRP	33	1	3%
UTHSC Houston/Medical School Ob/Gyn Res Program	33	1	3%
TTUHSC Lubbock Pediatric Residency Program	35	1	3%
UTMB Hospitals IMRP (Galveston)	210	6	3%
TTUHSC Amarillo FPRP	38	1	3%
UTHSC San Antonio Ob/Gyn Residency Program	40	1	3%
Central Texas Medical Foundation IMRP (Austin)	45	1	2%

	Total Residency Completers	Practicing in a Whole County Texas HPSA	Percent Practicing in a Whole Count TX HPSA
UTHSC Houston/Hermann LBJ Hospital IMRP	176	3	2%
Baylor College Of Medicine Ob/Gyn Res Program (Houston)	68	1	1%
Baylor College Of Medicine FPRP (Houston)	71	1	1%
McLennan County FPRP (Waco)	71	1	1%
UTHSC Houston/Hermann LBJ Hospital FPRP	80	1	1%
UTSWMC/Parkland Ob/Gyn Residency Program (Dallas)	83	1	1%
Baylor College Of Medicine Pediatric Residency Program (Houston)	216	2	1%
UTSWMC/Children's Med Center Ped Res Program (Dallas)	133	1	1%
Baylor College Of Medicine IMRP (Houston)	241	0	0%
Baylor Medical Center at Garland FPRP	21	0	0%
Baylor University Medical Center IMRP (Dallas)	62	0	0%
Baylor University Medical Center Ob/Gyn Residency (Dallas)	23	0	0%
Brazos Valley FPRP (Bryan)	18	0	0%
Methodist Hospitals Of Dallas IMRP	32	0	0%
Methodist Hospitals Of Dallas Ob/Gyn Res Program	10	0	0%
Parkland Memorial Hospital FPRP (Dallas)	11	0	0%
Scott & White/TAMUSHSC FPRP	45	0	0%
St Joseph Hospital Ob/Gyn Residency Program (Houston)	18	0	0%
St Paul Medical Center Ob/Gyn Residency Program (Dallas)	10	0	0%
St Paul-UTSW-Dallas FPRP	30	0	0%
St. Paul Medical Center IMRP (Dallas)	36	0	0%
Texarkana-St Michael's Hospital FPRP	37	0	0%
Tri-City Health Center Ob/Gyn Residency Program (Fort Worth)	1	0	0%
TTUHSC El Paso Ob/Gyn Residency Program	22	0	0%
UNTHSC Fort Worth IMRP	19	0	0%
UNTHSC-Fort Worth FPRP	2	0	0%
UNTHSC-Fort Worth Ob/Gyn Residency Program	8	0	0%
UTHSC Houston/Hermann LBJ Hosp Ob/Gyn Residency	31	0	0%
UTHSC Houston/Hermann LBJ Hosp Ped Res Program	73	0	0%
UTMB St Mary-Port Arthur FPRP	33	0	0%
UTSWMC Parkland Memorial Hospital IMRP	249	0	0%
Wichita Falls UTSW FPRP	45	0	0%
Total	4,250	172	

The majority of the programs (42) had very few of their residents, between one and nine percent, identified as practicing in a whole county HPSA, while 24 programs did not train any physicians identified as practicing in a whole county HPSA.

A total of 172 primary care physicians were identified as practicing in a whole county HPSA, representing just over 6 percent of the 2,669 residents who remained in Texas. The residency programs with 10 percent or more of their residents identified as practicing in a whole county HPSA produced 44 percent of such residents.

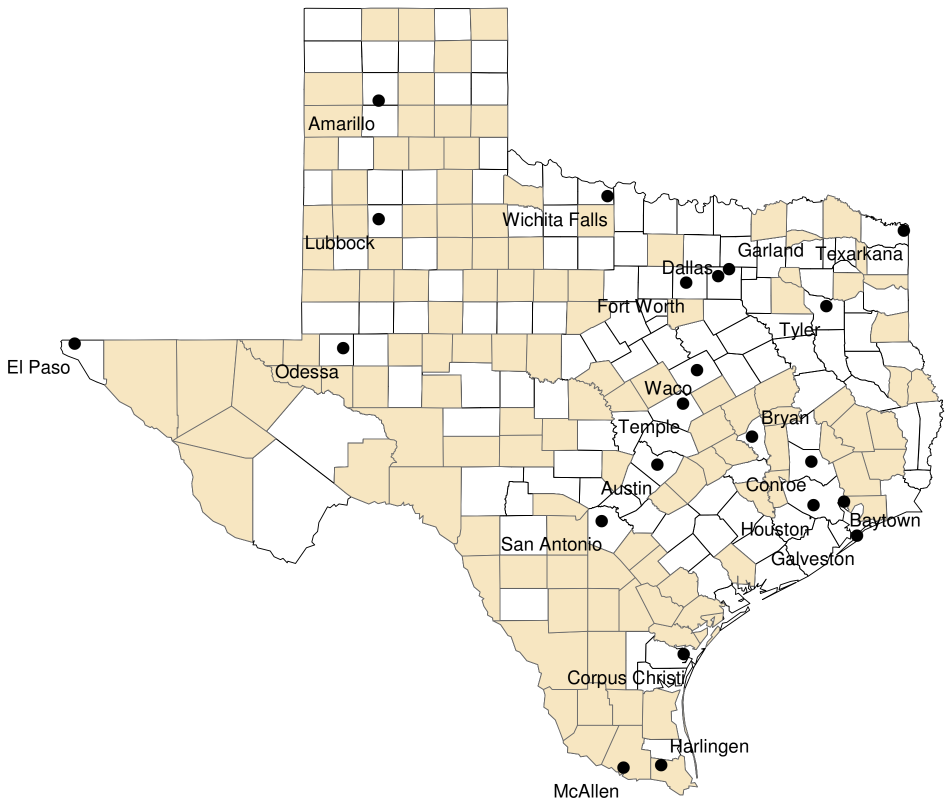
Variations by medical specialty were also identified. Family practice programs at 8.6 percent (n=89) and pediatric programs at 7.7 percent (n=36) produced greater numbers of residents who located in these less populated counties. At just 4.7 percent (n=14) obstetrics/gynecology and internal medicine programs at 3.7 percent (n=32) had fewer residents practicing in whole county HPSAs. Table 4.14. shows the number of residency programs by specialty, the number of residents identified as practicing in Texas and the number practicing in a whole county HPSA.

Table 4.14. *Number of Residents by Specialty Practicing in Texas and Practicing in Texas Whole County HPSAs*

Residency Type	Number of Programs	Primary Care Residents	Percent of Study Population	In Texas	Percent In Texas	In Whole County HPSA	Percent In Whole County HPSA
Family Practice	32	1,459	34.3%	1,037	71%	89	8.6%
Internal Medicine	15	1,498	35.2%	863	58%	32	3.7%
Obstetrics/Gynecology	19	497	11.7%	296	60%	14	4.7%
Pediatric	11	796	18.7%	470	59%	36	7.7%
Total	77	4,250	100%	2,666	63%	171	6.4%

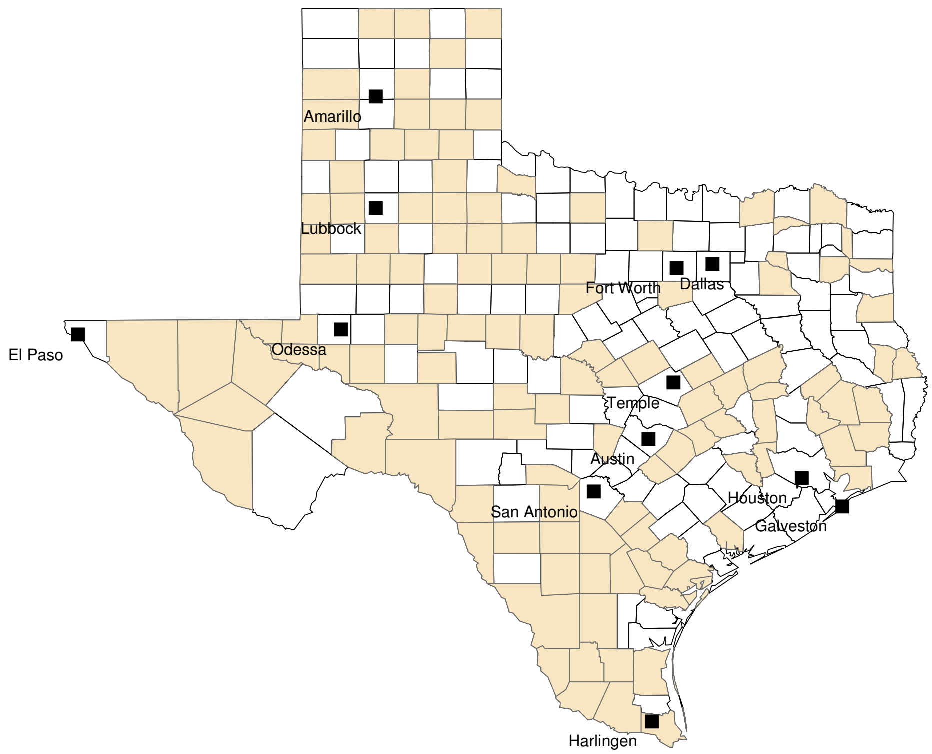
Geographic location of the residency programs that produced physicians who located in whole county HPSAs was also noted. Pediatric and Obstetric/Gynecology residency programs located in more rural or remote areas of the state (Amarillo and Odessa) produced greater numbers of physicians practicing in whole county HSPAs; however, one of these programs had only 12 residents complete training during the study period. Additionally, 24 of the residency programs studied did not train any physicians practicing in a whole county Texas HPSA. Notably, the residency program with the most completers during the study period trained 249 internists, and none located in a whole county Texas HPSA. Figures 4.6. through 4.9. show the location of the residency programs in relation to the whole county HPSAs.

Figure 4.6. *Family Practice Residency Programs and Whole County HPSA*



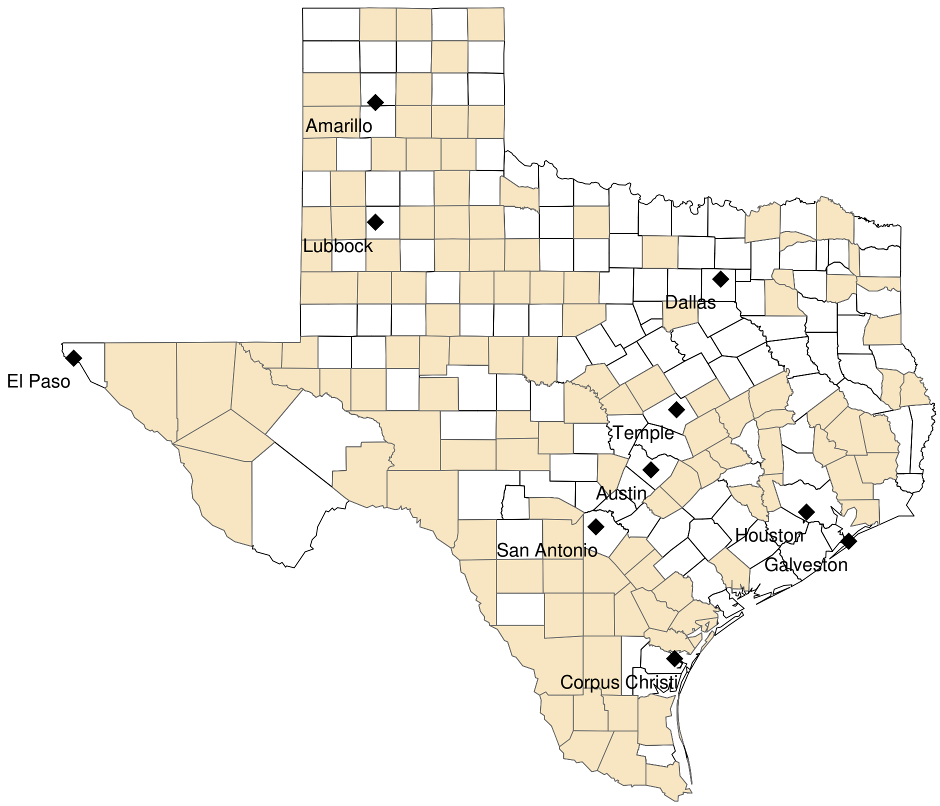
Source: Texas Department of State Health Services, Whole County HPSAs, 2006

Figure 4.7. *Internal Medicine Residency Programs and Whole County HPSAs*



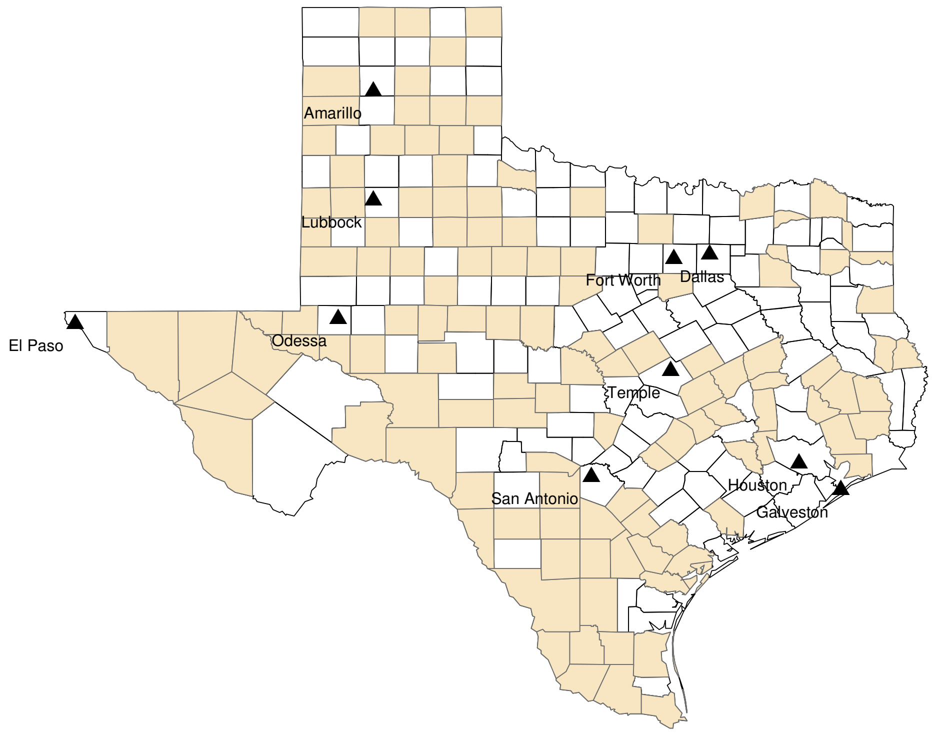
Source: Texas Department of State Health Services, Whole County HPSAs, 2006

Figure 4.8. *Pediatric Residency Programs and Whole County HPSAs*



Source: Texas Department of State Health Services, Whole County HPSAs, 2006

Figure 4.9. *Obstetric/Gynecology Residency Programs and Whole County HPSAs*



Source: Texas Department of State Health Services, Whole County HPSAs, 2006

Summary of Frequency Distributions and Geographic Depictions

The frequency distributions and the corresponding depictions present an overview of the residency programs in the study and show their geographic relationship to whole county HPSAs. Program data were presented that showed the number of physicians trained during the study period in each program. Additionally, frequency distributions were presented that showed by program the number of residents identified in the state's neediest areas, the whole county HPSAs. To understand the relationship between physician practice location and residency data collected, Chi-Squares tests of significance were conducted. These results are presented in the next section.

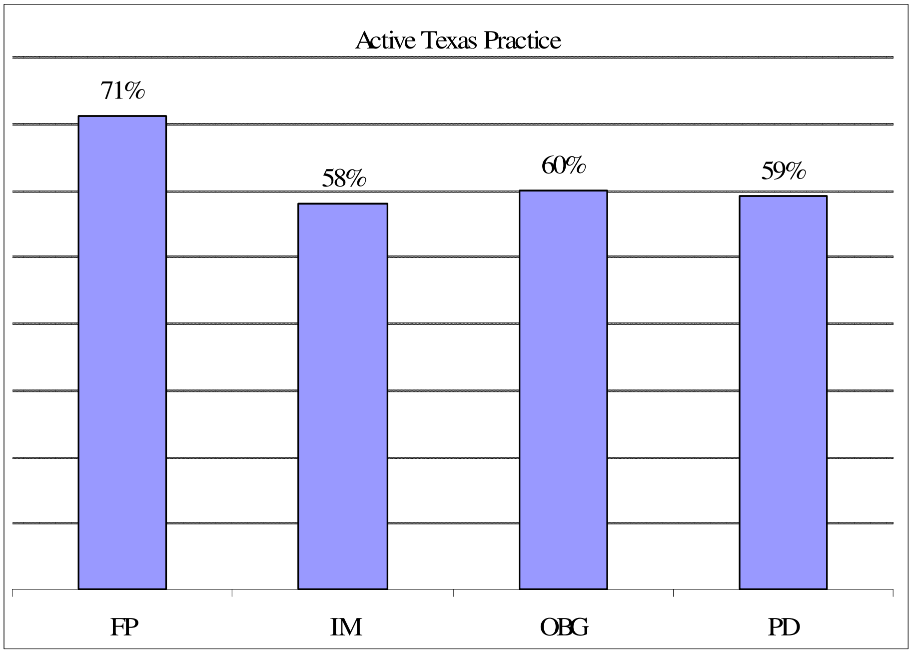
Chi-Square Tests of Significance

Chi-Square statistics were calculated to determine if residency type, medical school of graduation, ethnicity, gender, whether the residency program was located in a medical school, size of the community the residency program was located in, medical degree, U.S. citizenship, and baccalaureate institution location were related to practice in Texas ($p \leq .05$). The "Comprehensive Data Set" was used for all analyses, except the analysis of baccalaureate institution location. Because limited data were available on this variable, a subset, "Potential Texas Undergraduates" was used to explore the relationship between remaining in Texas and obtaining a bachelor's degree from a Texas public higher education institution. However, the baccalaureate institution location was removed from further analysis, since confirmation of the data was limited. Chi-Square statistics were also calculated to determine if these same variables were related to practice in whole county HPSAs ($p \leq .05$). A subset of the "Comprehensive Data Set," the "In Texas Data Set" was used in these analyses.

Practice in Texas

The following data analyses present the characteristics significantly related to resident physicians electing to remain in Texas following residency completion. The data set used in these analyses was the "Comprehensive Data Set" as defined in Chapter 3. This data set was comprised of all 4,250 Texas primary care physicians who completed residency training between 1996 and 2001. Of the residents studied, family physicians were more likely to have active Texas practices than the other primary care specialties, as shown in Figure 4.10. Obstetrics/gynecology residents, pediatric residents, and internal medicine residents remained in Texas at similar rates, about 60 percent of the time. Internal medicine residents were the least likely to remain. This may reflect the sub-specialization of internists, who may continue sub-specialty training outside the state. While obstetrician/gynecologist programs trained fewer residents overall, 60 percent of those trained remained in Texas and held active Texas medical licenses. However, 71 percent of family physicians remained in Texas following their residency training.

Figure 4.10. *Active Texas Practice by Specialty Type*



FP = Family Practice; IM = Internal Medicine; OBG = Obstetrics/Gynecology; and PD = Pediatric Residency programs

The Chi-Square test showed that there were significant differences among the four types of primary care specialties in terms of whether they remained in Texas to practice following completion of residency training. Family practice residents were significantly more likely to remain. A p-value less than .05 indicates this was a statistically significant finding.

Table 4.15. *Active Texas Practice, Residency Type Cross Tabulation*

		Residency Type				
		FP	IM	OBG	PD	Total
In Texas	Count	1,037	863	299	470	2,669
	% within Residency Type	71.1%	57.6%	60.2%	59.0%	62.8%
Not In Texas	Count	422	635	198	326	1,581
	% within Residency Type	28.9%	42.4%	39.8%	41.0%	37.2%
Total	Count	1,459	1,498	497	796	4,250
	% within Residency Type	100.0%	100.0%	100.0%	100.0%	100.0%

Note: FP = Family Practice; IM= Internal Medicine; OBG = Obstetrics/Gynecology; PD = Pediatric

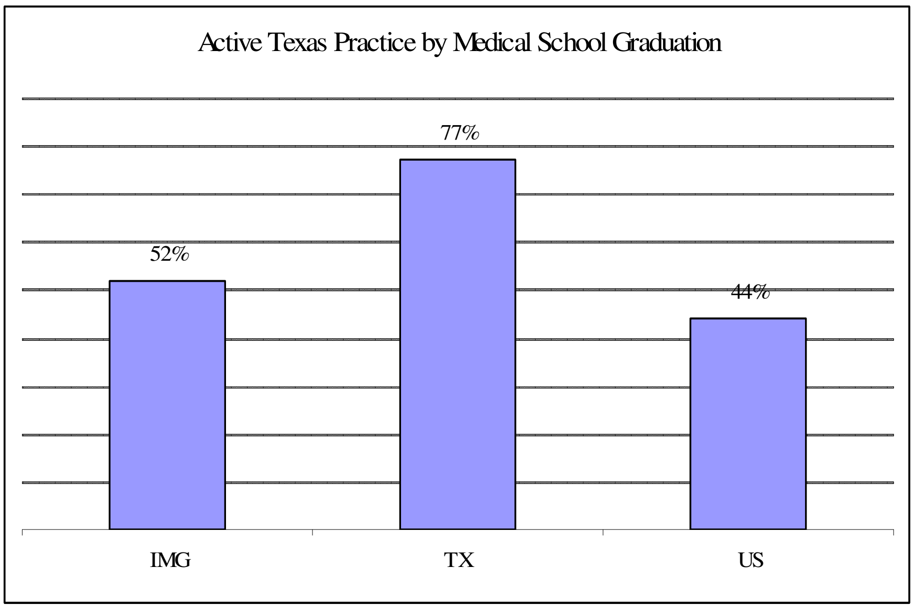
Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	66.333(a)	3	.000

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 184.88.

A Chi-Square test was conducted to determine if there were statistically significant differences within the study population, based on where residents graduated from medical school. The population was categorized into three groups: Texas medical school graduates, international medical graduates (IMGs), and graduates from non-Texas/other U.S. medical schools. As shown in Figure 4.11, residents who graduated from Texas medical schools were the most likely to remain in the state to practice. The group identified as IMGs, which included U.S. citizens who obtained their medical degree abroad and visitors from foreign countries, were much less likely to remain in Texas than Texas medical school graduates. Only slightly more than half of IMGs remained in the state. The physicians who graduated from non-Texas U.S. medical schools were least likely to remain in Texas to practice. In fact less than half were identified as doing so.

Figure 4.11. *Active Texas Practice by Medical School Graduation*



Note: IMG = International Medical Graduate; TX = Texas Medical School Graduate; US = Other Non-Texas US Medical School

These differences were found to be statistically significant, as shown in Table 4.16.

Table 4.16. *Active Texas Practice, Medical School of Graduation Type Cross Tabulation*

		Medical School of Graduation			
		IMG	Texas	Non-Texas/ Other U.S.	Total
In Texas	Count	428	1,710	531	2,669
% within Medical School of Graduation		52.4%	76.7%	44.2%	62.8%
Not in Texas	Count	389	520	670	1,579
% within Medical School of Graduation		47.6%	23.3%	55.8%	37.2%
Total	Count	817	2,230	1,201	4,248
% within Medical School of Graduation		100%	100%	100%	100%

Total=4,248; 2 residents did not report school of graduation.

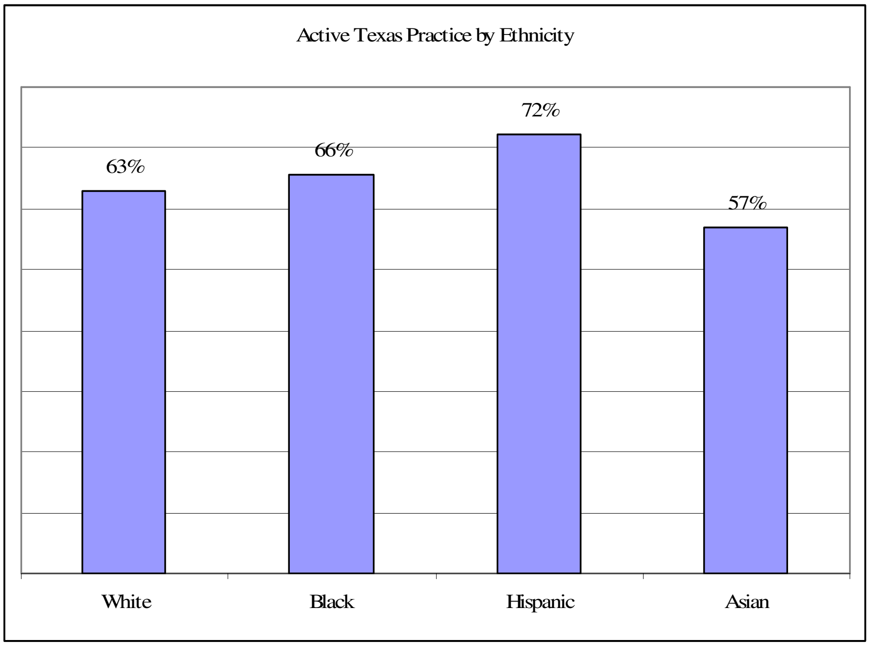
Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	399.596(a)	2	.000

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 303.68.

Significant ethnic group differences were also found. As shown in Figure 4.12, 72 percent of Hispanic residents remained in Texas to practice, 66 percent of Black residents remained, 63 percent of White residents remained, and 57 percent of Asian residents remained.

Figure 4.12. *Active Texas Practice by Ethnicity*



As shown in Table 4.17, the Chi-Square test showed that the differences among ethnic groups were significant (p.<05).

Table 4.17. *Active Texas Practice, Ethnicity Cross Tabulation*

		Ethnicity				
		White	Black	Hispanic	Asian	Total
In Texas	Count	1,510	158	424	562	2,654
% within Ethnicity		63%	65.6%	72.1%	56.9%	63%
Not in Texas	Count	886	83	164	426	1,559
% within Ethnicity		37%	34.4%	27.9%	43.1%	37%
Total	Count	2,396	241	588	988	4,213
% within Ethnicity		100%	100%	100%	100%	100%

Total=4,213; 33 residents were removed from this analysis as they reported unknown or no ethnicity; an additional four American Indian/Pacific Islander were also removed because of small numbers.

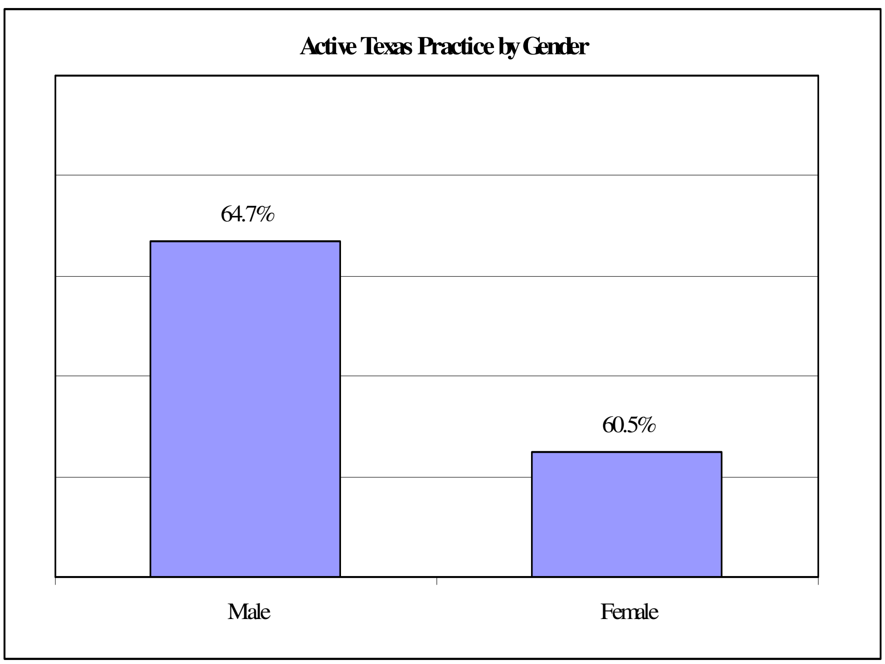
Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.008(a)	3	.000

a 0 cells (0%) have expected count less than 5. The minimum expected count is 89.17.

A Chi-Square test was conducted to analyze gender differences as they related to residents remaining in Texas to practice. Slightly less than 65 percent of male residents remained in Texas to practice, while slightly less than 61 percent of females remained in Texas. These differences are shown in Figure 4.13.

Figure 4.13. *Active Texas Practice by Gender*



The Chi-Square test showed that this difference was statistically significant (p. <05).

This is shown in Table 4.18.

Table 4.18. *Active Texas Practice, Gender Cross Tabulation*

		Gender		
		Male	Female	Total
In Texas	Count	1,548	1,118	2,666
% within Gender		65%	60%	63%
Not in Texas	Count	845	731	1,576
% within Gender		35%	40%	37%
Total	Count	2,399	1,849	4,242
% within Gender		100.00%	100.00%	100.00%

Total=4,242; eight residents were removed as they did not report gender.

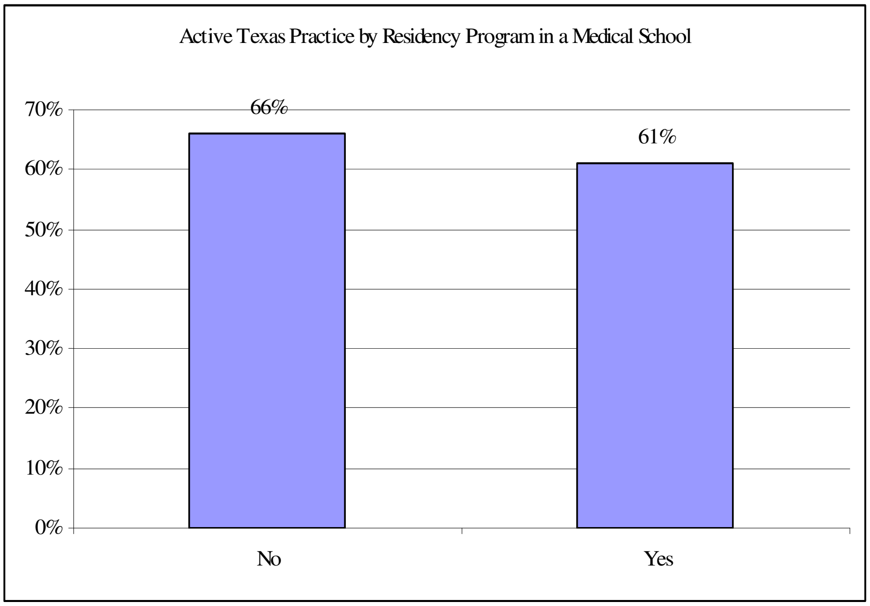
Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.969(b)	1	.005

a Computed only for a 2x2 table
b 0 cells (0%) have expected count less than 5. The minimum expected count is 686.95.

Resident physicians were somewhat more likely to remain in Texas if they completed their training in a program that was physically located away from a medical school. Sixty-six percent of residents trained in programs located away from medical schools remained in Texas to practice, while only 61 percent of residents trained in programs located in medical schools did so. This is shown in Figure. 4.14.

Figure 4.14. *Active Texas Practice by Residency Program Located in a Medical School*



As shown in Table 4.19, this difference was statistically significant (p<.05). However, it is possible that the fact that residency programs located within a medical school were located primarily in large metropolitan counties may have played a role in this finding.

Table 4.19. *Active Texas Practice, Residency Program Located in a Medical School Cross Tabulation*

		Residency Located in a Medical School		Total
		No	Yes	
In Texas	Count	1,006	1,662	2,668
	% within Residency in Medical School	66%	61%	63%
Not In Texas	Count	516	1,065	1,581
	% within Residency in Medical School	34%	39%	37%
Total	Count	1,522	2,727	4,249
	% within Residency in Medical School	100.0%	100.0%	100.0%

Total =4,249; one resident was removed as no medical school was reported.

Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.094(b)	1	.001

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 566.32.

To explore this relationship further, residency programs were grouped according to community size, as defined in Chapter 3. The “large metro” designation was based on 2000 Census Bureau data and included the following locations: Austin, El Paso, Dallas, Fort Worth, Galveston/Baytown (due to proximity to Houston), Houston, and San Antonio. Smaller communities included Corpus Christi, Amarillo, Lubbock, Temple, Odessa, Port Arthur, Tyler, Texarkana, Waco, McAllen, Wichita Falls, Bryan, Groves, and Harlingen. The large cities all had populations in excess of 500,000 and most had a significant medical school presence. The cities coded as smaller communities had approximately half the population in 2000 as the large cities. Interestingly, there was no statistically significant difference between residents graduating from programs in large communities and compared with those from smaller areas. This is shown in Table 4.20.

Table 4.20. *Active Texas Practice, Residency Program Location Community Size Cross Tabulation*

		Residency Location Large Community		Total
		No	Yes	
In Texas	Count	2,054	614	2,668
% within Residency in Large Community		62.3%	64.6%	62.8%
Not In Texas	Count	1,244	337	1,581
% within Residency in Large Community		35.4%	37.7%	37.2%
Total	Count	951	3,298	4,249
% within Residency in Large Community		100.0%	100.0%	100.0%

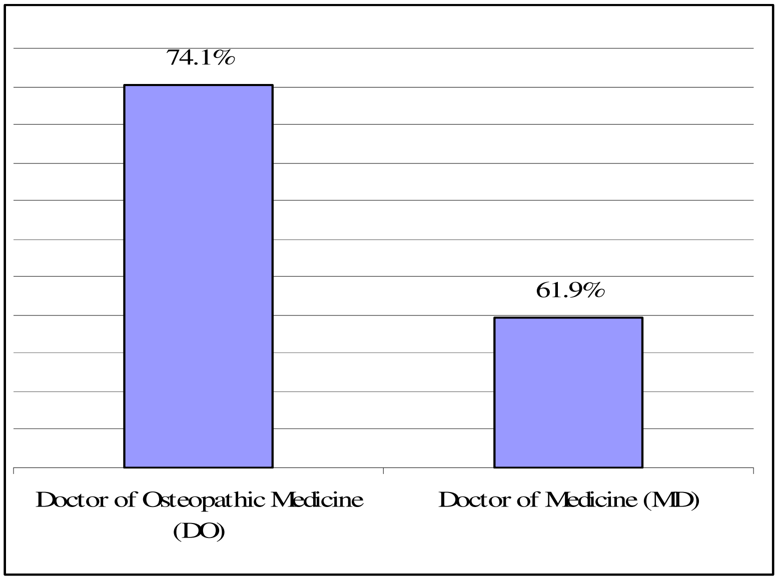
Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.1647(b)	1	.199

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 353.86.

The type of medical degree earned by physicians before entering a residency program was found to be related to remaining in Texas to practice. Seventy-four percent of residents who had received a Doctor of Osteopathic Medicine (DO) degree remained in Texas to practice, while only 62 percent of residents who had received the Doctor of Medicine (MD) degree did so. This is shown in Figure 4.15.

Figure 4.15. *Active Texas Practice by Type of Degree, DO or MD*



This difference was statistically significant (p.<.05), as shown in Table 4.21.

Table 4.21. *Active Texas Practice, Type of Medical Degree, Cross Tabulation*

		Medical Degree		Total
		Doctor of Osteopathic Medicine (DO)	Doctor of Medicine (MD)	
In Texas	Count	243	2,426	2,669
	% within Degree	74%	62%	63%
Not In Texas	Count	85	1,496	1,581
	% within Degree	26%	38%	37%
Total	Count	328	3,922	4,250
	% within Degree	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.377(b)	1	.000

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 122.02.

The “Potential Texas Undergraduate” subset of “Comprehensive Data Set” was used to explore the relationship between obtaining a baccalaureate degree from a public Texas higher education institution and practicing in Texas. The subset (n=3,349) included the residents who potentially could have graduated from a Texas public college or university, as described in Chapter 3. The results showed that 81 percent of residents identified as graduating from a Texas public college or university were identified as practicing in Texas. Table 4.22 shows the number of residents who were identified as practicing in Texas. The Chi-Square test showed statistical significance. However, because the data assumptions used to compile this data set were set by proxy based on age, this data set was not included in the whole county HPSA anaylsis.

Table 4.22. *Active Texas Practice by Texas Bachelor's Degree, Cross Tabulation*

		Texas Bachelor's Degree		Total
		No	Yes	
In Texas	Count	1,277	761	2,038
% within Bachelor's Degree		53%	81%	61%
Not In Texas	Count	1,132	179	1,311
% within Bachelor's Degree		47%	19%	39%
Total	Count	2,410	939	3,349
% within Bachelor's Degree		100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	182.166(b)	1	.000

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 306.42.

A Chi-Square test was also conducted on the variable, citizenship. While the results showed that U.S. citizens were significantly more likely to remain in Texas to practice, this variable was removed from further consideration, since those residents who do not have U.S. citizenship must leave the country following residency training. This renders this analysis almost meaningless for this study.

Practice in Texas Whole County Health Professional Shortage Area

Chi-Square tests were conducted to determine if residency type, medical school of graduation, ethnicity, gender, and whether the residency program was located in a medical school were related to practicing in a Texas whole county HPSA. The variables concerning citizenship and the resident's baccalaureate institution were not included in this analysis. As mentioned previously citizenship would likely provide statistically significant, but meaningless results, since non-U.S. citizens would not stay in Texas following completion of residency training because of immigration laws. Resident's baccalaureate institution was removed because of data quality issues. The data set used in this analysis was the "In-Texas Data Set" as defined in Chapter 3. This data set, a subset of the "Comprehensive Data Set", was comprised of the 2,669 Texas primary care residents who were identified as practicing in Texas as of March 2005.

Although only 6.4 percent of all residents in the study were found to be practicing in HPSAs, family practice residents (at 8.6%) and pediatric residents (at 7.7%) were significantly more likely to practice in these areas than were obstetrics/gynecology residents (at 4.7%) or internal medicine residents (at 3.7%) Table 4.23 shows these results, and that fact that these differences were significant.

Table 4.23. *Active Texas Whole County HPSA practice, Residency Type Cross Tabulation*

		Residency Type				
		FP	IM	OBG	PD	Total
In Texas Whole County HPSA	Count	89	32	14	36	171
	% within Residency Type	8.6%	3.7%	4.7%	7.7%	6.4%
Not in Texas Whole County HPSA	Count	948	831	285	434	2498
	% within Residency Type	91.4%	96.3%	95.3%	92.3%	93.6%
Total	Count	1,037	863	299	470	2,669
	% within Residency Type	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.381(a)	3	.000

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 19.16.

As shown in Table 4.24, International Medical Graduates (IMGs) (at 15.2%) were roughly three times as likely to locate in a whole county HPSA as Texas medical school graduates (at 5.2%), and almost five times as likely as graduates from non-Texas/US medical schools (at 3.2%). The Chi-Square test in this case showed that these differences were statistically significant (p<.05).

Table 4.24. *Active Texas Whole County HPSA practice by Medical School Location Cross Tabulation*

		Medical School Location			Total
		IMG	TX	US	
In a Whole County HPSA	Count	65	89	17	171
% within Medical School Location		15.2%	5.2%	3.2%	6.4%
Not in a Whole County HPSA	Count	363	1621	514	2,498
% within Medical School Location		84.8%	94.8%	96.8%	93.6%
Total	Count	428	1710	531	2,669
% within Medical School Location		100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	68.243(a)	2	.000

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 27.42.

Statistically significant differences were also found by ethnic group. As shown in Table 4.25, Hispanic residents (at 18.2%) were far more likely to practice in a whole county HPSA than were Asians (5.2%), Blacks (5.1%), or Whites (3.7%). As shown by the Chi-Square test, these differences were significant ($p<.05$).

Table 4.25. *Active Texas Whole County HPSA Practice by Ethnicity, Cross Tabulation*

		Ethnicity				
		White	Black	Hispanic	Asian	Total
In a Whole County HPSA	Count	56	8	77	29	170
% within Ethnicity		3.7%	5.1%	18.2%	5.2%	6.4%
Not in a Whole County HPSA	Count	1,454	150	347	533	2,484
% within Ethnicity		96.3%	94.9%	81.8%	94.8%	94%
Total	Count	1,510	158	424	562	2,656
% within Ethnicity		100%	100%	100%	100%	100%

Total=2,656; Eleven residents did not report ethnicity; two American Indian/Pacific Islander were removed because of small numbers.

Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	118.192(a)	3	.000

a 0 cells (0%) have expected count less than 5. The minimum expected count is .13.

Differences were also noted by gender and locating a whole county HPSA. Just over eight percent of male residents were identified as practicing in a whole county HPSA, while only four percent of female residents did so. While very few of the total number of medical residents were identified as practicing in whole county HPSAs, males were twice as likely as females to do so. These results are shown below in Table 4.26. The Chi-Square test shows that this difference was statistically significant (p<.05).

Table 4.26. *Active Texas Whole County HPSA Practice by Gender*

		Gender		Total
		Female	Male	
In a Whole County HPSA	Count	45	126	171
% within Gender		4.0%	8.1%	6.4%
Not in a Whole County HPSA	Count	1,073	1,422	2,495
% within Gender		96.0%	91.9%	93.6%
Total	Count	1,118	1,548	2,666
% within Gender		100.0%	100.0%	100.0%

Total=2,666; three residents did not report gender.

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.308(b)	1	.000

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 71.71.

Statistically significant differences were noted in residents identified as practicing in a whole county HPSA depending on whether the location of their residency program was in a medical school setting or not. Residents who completed training in program outside a medical school were more than twice as likely (at 10.5%) to practice in a Texas whole county HPSA than their counterparts who completed their residency program in a medical school setting. These results, and the fact that the differences were statistically significant, are shown in Table 4.27.

Table 4.27. *Active Texas Whole County HPSA by Residency Program Located in a Medical School Cross Tabulation*

		Residency Located in a Medical School		Total
		No	Yes	
In a Whole County HPSA	Count	106	65	171
% within Residency in Medical School		10.5%	3.9%	6.4%
Not in a Whole County HPSA	Count	900	1,598	2,498
% within Residency in Medical School		89.5%	96.1%	93.6%
Total	Count	1,006	1,663	2,669
% within Residency in Medical School		100.0%	100.0%	100.0%

Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	45.865(b)	1	.000

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.48.

As previously mentioned, this relationship was analyzed further because most medical schools are located in large urban areas. In the case of whole county HPSA, this additional analysis was instructive. Residents who completed their program in a large community (at 4.7%) were significantly less likely to locate in a whole county HPSA, than were residents who completed their program in less populated communities (at 12.2%). A Chi-Square test shows this in Table 4.28.

Table 4.28. *Active Texas Whole County HPSA, Residency Program Location Community Size Cross Tabulation*

		Residency Location in a Large Community		Total
		No	Yes	
In a Whole County HPSA	Count	75	96	171
% within Residency Large Community		12.2%	4.7%	6.4%
Not in a Whole County HPSA	Count	539	1959	2,498
% within Residency Large Community		87.8%	95.3%	93.6%
Total	Count	614	2,054	2,668
% within Residency Large Community		100.0%	100.0%	100.0%

Chi-Square Test

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.814(b)	1	.000

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 39.35.

However, the analysis revealed that the type of medical degree was not particularly important in identifying those residents who decided to practice in a whole county HPSA. Residents with the degree Doctor of Osteopathic medicine (at 7%) were more likely to practice in a whole county HPSA than were residents who held the degree Doctor of Medicine (at 6.3%), but the difference was not statistically significant. This is shown below in Table 4.29.

Table 4.29. *Active Texas Whole County HPSA Practice by Type of Medical Degree Cross Tabulation*

		Medical Degree		Total
		Doctor of Osteopathic Medicine (DO)	Doctor of Medicine (MD)	
In a Whole County HPSA In Texas	Count	17	154	171
% within Degree		7.0%	6.3%	6.4%
Not In Texas	Count	226	2,272	2,498
% within Degree		93%	93.7%	93.6%
Total	Count	243	2,426	2,669
% within Degree		100.0%	100.0%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.155(b)	1	.694

a Computed only for a 2x2 table
b 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.57.

Summary of Chi-Square Tests

The Chi-Square analysis found significant relationships among the majority of the variables studied. Statistically significant differences were found by type of residency program, location of medical school graduation, ethnicity, gender, and location of residency program as they related to remaining in Texas. Similar statistically significant results were found in relationship to practicing in a Texas whole county HPSA. While these tests showed statistically significant differences, the results provided no predictive power. In order further explore the variables and understand the relationships between the variables to the study questions related to remaining in Texas and practicing in a whole county HPSA, logistical regression analyses were conducted.

Binary Logistic Regression Analysis

The binary logistic regression analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 15.0 to explore the relationships between the demographic variables identified as statistically significant in the Chi-Square analysis and the likelihood of physicians remaining in Texas to practice. This analysis was conducted to evaluate whether the demographic variables could be used as independent variables to develop a model that would predict the likelihood of membership in a group-- that is, physicians practicing in Texas following their residency training, the dependent variable in the analysis. A similar binary logistic regression analysis was carried out to explore whether the variables could be used to predict whether physicians would remain in Texas and practice in whole county HPSAs. These analyses were conducted using the "Comprehensive Data Set" and the "In Texas Data Set," respectively. Results of each of these analyses follow, beginning with those from the "Comprehensive Data Set".

Exploring Remaining In Texas Using "Comprehensive Data Set"

From the original 4,250 residents in the study population or "Comprehensive Data Set," 39 cases were removed because of missing data, including gender and medical school of graduation. The remaining 4,211 cases were used in the binary logistical regression analysis. The following variables were included in the analysis: medical school location (Texas, IMG, other non-Texas/ US), degree type (MD/DO), residency type (Family Practice, Internal Medicine, Pediatric, Obstetric/Gynecology), residency program location (in a medical school or not), gender (male/female), and ethnicity (White, Black, Hispanic, Asian).

The first step in a binary logistic regression analysis is to test for multicollinearity. Multicollinearity exists when the independent variables are essentially measuring the same phenomenon. Collinearity diagnostics were performed to ensure that redundancy or overlap of the independent variables was not a concern. This was done because a strong correlation between the independent variables would skew the results of the binary logistical regression analysis. The results of these diagnostic tests, shown in Table 4.30, indicate that the tolerance levels for each of the independent variables exceeded .7 and the Variance Inflation Factor levels were below 2. These findings mean that the independent variables were not highly correlated with each another; therefore multicollinearity was not a concern.

Table 4.30. *Active Texas Practice, Coefficients, Collinearity Statistics*

Coefficients(a)

Model		Collinearity Statistics	
		Tolerance	Variance Inflation Factor
1	Medical School Location	.892	1.121
	Degree (MD/DO)	.951	1.052
	Residency Type (FP, IM, Peds, Ob/Gyn)	.848	1.179
	Residency Program in a Medical School (yes/no)	.896	1.116
	Gender (Male/Female)	.966	1.035
	Ethnicity (White, Black, Hispanic, Asian)	.917	1.091

a Dependent Variable: Active Texas Practice

Next, the “enter method” was used in the logistic regression itself. In this method all independent variables are entered into the model, regardless of their significance levels. The method is often used when, as was true in this study, the independent variables have been previously tested.

Three sets of results are reported for this analysis, including statistics for overall model fit, a classification table, and summary of model variables. Statistics for overall model fit are presented in Table 4.31. The -2 Log Likelihood statistic provides an index of model fit. A perfect model would have a -2 Log Likelihood of 0; so the closer the value is to 0, the better the overall model fits the data. The Cox and Snell R Square and the Nagelkerke R Square represent two different estimates of the amount variance in the dependent variable accounted for by the independent variables.

Table 4.31. *Active Texas Practice Model Summary, Binary Logistical Regression*

Step	-2 Log Likelihood	Cox & Snell R Square	Nagelkerke R Square
1	5061.533(a)	.109	.149

a Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

As shown in Table 4.31, the value of the -2 Log Likelihood was high, suggesting that the model fit is poor. The Cox and Snell R Square and Nagelkerke R Square statistics indicate that the independent variables explained between 11 and 15 percent of the variance in the likelihood of the residents in this study to practice in Texas.

Another statistic which measures model fit is the Hosmer and Lemeshow Goodness of Fit test. This test divides subjects, in this case the primary care residents, into deciles based on predicted probabilities, computes a Chi-Square from observed and expected frequencies, and then calculates a p-value (G. David Garson, 2007). If the p-value is greater than .05, the null hypothesis that there is no difference between expected and observed values of the dependent variable is rejected. This suggests that the model's estimates fit the data at an acceptable level. However, this does not mean that the model explains much of the variance in the dependent variable, only that the model does so to a significant degree. As shown in Table 4.32, the Hosmer and Lemeshow Goodness of Fit test in this analysis produced a p-value of .07, suggesting that the model was a good fit. As shown in Table 4.32, however, the amount of variance accounted for by the model was not very high.

Table 4.32. *Hosmer and Lemeshow Test*

Step	Chi-Square	df	Sig.
1	14.486	8	.07

The Classification Table produced by the analysis is shown in Table 4.33. It tallies correct and incorrect estimates for the full model of the independent variables. The columns include the two predicted values of the dependent variable, and the rows show the two observed values of the dependent variable. The overall model correctly predicted 67 percent of the values, which seems moderately good since any percentage above 50 percent is considered better than chance. Given that the model in this analysis correctly predicted values of the dependent variable at a level 17 percentage points greater than chance, this implies that some portion of Active Texas Practice by residents can be predicted by the independent variables in this study.

Table 4.33. *Active Texas Practice, Classification Table*

	Observed		Predicted Active Texas Practice No	Predicted Active Texas Practice Yes	Percentage Correct
Step 1	Active Texas Practice	No	725	833	46.5
		Yes	551	2102	79.2
	Overall Percentage				67.1

a The cut value is .500

Table 4.34 shows the third set of results produced by the analysis, a summary of model variables. The columns identified as B (Beta) and S.E. (Standard Error) are used to establish the Wald statistic. The ratio of the coefficient B to its standard error S.E., squared, equals the Wald statistic, shown in the next column. The Wald statistic and corresponding significance level show the independent variables used in the model and provide their significance level. For example, if the Wald statistic is significant (less than .05), the representative variable is significant within the model. Of the independent variables the following were identified as significant predictor variables to identify physicians likely to practice in Texas: medical school location (Texas and IMG), type of degree (DO), residency type (family practice), gender (male), and ethnicity (Black and Hispanic).

The column identified as Exp(B) represents the odds ratio between the independent variables with the dependent variable. It is the predicted change in odds for a unit increase in an independent variable when there is an increase in the dependent variable. Odds ratios less than 1 correspond to decreases in the odds of a change in the dependent variable and odds ratios more than 1.0 correspond to increases in odds of a change in the dependent variable. Odd ratios close to 1 indicate that a change in a unit of an independent variable has little or no corresponding affect on the dependent variable (Garson, 2007).

Table 4.34. *Active Texas Practice, Variables in the Equation*

		B	S.E.	Wald	Df	Sig.	Exp(B)	95.% Confidence Interval for Exp(B)	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Step 1(a)	Medical School Location			357.565	2	.000			
	Medical School Location, Texas	1.096	.096	129.480	1	.000	**2.992**	2.477	3.613
	Medical School Location, IMG	-.331	.104	10.174	1	.001	.718	.586	.880
	Degree (DO)	-.382	.144	7.069	1	.008	.682	.515	.904
	Residency Type			17.757	3	.000			
	Residency Type Family Practice	.255	.105	5.889	1	.015	**1.291**	1.050	1.587
	Residency Type Internal Medicine	-.125	.097	1.662	1	.197	.883	.730	1.067
	Residency Type Pediatric	.013	.127	.010	1	.920	**1.013**	.790	1.298
	Residency in a Medical School (No)	.031	.079	.154	1	.695	**1.031**	.884	1.204
	Gender Male	.182	.070	6.674	1	.010	**1.199**	1.045	1.377
	Ethnicity			37.131	3	.000			
	Ethnicity White	.025	.088	.084	1	.772	**1.026**	.863	1.219
	Ethnicity Black	.580	.161	12.924	1	.000	**1.787**	1.302	2.451
	Ethnicity Hispanic	.548	.118	21.384	1	.000	**1.729**	1.371	2.181
	Constant	.184	.188	.963	1	.327	1.202		

a Variable(s) entered on step 1: Medical School Location, Degree, Residency Type, Residency Program in a Medical School, Gender and Ethnicity

The binary logistic regression equation shows that the location of the medical school from which a resident graduated was the most powerful predictor (Exp(B) value, 2.992) of whether the resident would practice in Texas following residency training. In fact graduates from Texas medical schools who did their residency training in Texas were almost three times as likely to actively practice in Texas. Interestingly, family practice residents and male residents were a little more likely to remain in Texas to practice, while Black and Hispanic residents were a lot more likely to remain.

Exploring In Texas Whole County HPSA Using "In Texas Data Set"

To explore the independent variables associated with predicting whether residents locate in a Texas whole county HPSA to practice, logistic regression analysis was conducted using the "In Texas Data Set." The same steps were followed for this analysis as were conducted using the "Comprehensive Data Set" to determine the independent variables and their predictive power for residents remaining in Texas. Six variables were included in this logistical regression analysis: medical school of graduation (Texas, IMG, other non-Texas/US), degree (MD/DO), residency type (Family Practice, Internal Medicine, Pediatric, Obstetric/Gynecology), residency location in a medical school, gender (male/female), and ethnicity (White, Black, Hispanic, and Asian).

The results of the multicollinearity diagnostic test, displayed in Table 4.35, show that the tolerance levels exceeded .7 and Variance Interval Factor levels were below 2, indicating that the independent variables were not highly correlated to each another; therefore multicollinearity was not a concern.

Table 4.35. *Texas Whole County HPSA, Coefficients, Collinearity Statistics*

Coefficients(a)

Model		Collinearity Statistics	
		Tolerance	VIF
1	Medical School Location	.904	1.106
	Degree (MD/DO)	.960	1.042
	Residency Type (FP, IM, Peds, Ob/Gyn)	.850	1.177
	Residency Program in a Medical School (yes/no)	.897	1.115
	Gender (Male/Female)	.968	1.033
	Ethnicity (White, Black, Hispanic, Asian)	.917	1.091

a Dependent Variable: Texas Whole County HPSA

The "enter method" was used again in this analysis. The same three sets of results are presented for this analysis as were presented in the previous analysis. Statistics for overall model fit are presented in Table 4.36.

Table 4.36. *Texas Whole County HPSA, Model Summary*

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1078.458(a)	.067	.177

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The -2 Log Likelihood was again high, suggesting that the model fit is poor. The Cox and Snell R Square and the Nagelkerke R Square statistics suggest that the model predicted between six percent (Cox and Snell) and 18 percent (Nagelkerke) of the variance in the likelihood of residents in this study practicing in a Texas Whole County HPSA.

The Hosmer and Lemeshow Goodness of Fit test, presented in Table 4.37, shows that with a p-value of .158, the model is a strong fit for the measure. If the significance value is greater than .05, as it is here, the null hypothesis that there is no difference between expected and observed is rejected (Garson, 2007). This suggests that the model's estimates fit the data at a strong level. However, as previously noted, this does not mean that the model explains much of the variance in the dependent variable, only that the model does so to a significant degree.

Table 4.37. *Texas Whole County HPSA, Hosmer and Lemeshow Test*

Step	Chi-Square	df	Sig.
1	11.845	8	.158

The Classification Table is shown in Table 4.38. This tallies correct and incorrect estimates for the full model of the independent variables. The columns include the two predicted values of the dependent variable, and the rows show the two observed values of the dependent variable. The overall model correctly predicted 94 percent, which seems excellent. However, this is misleading, as all predicted classifications were placed into the "no" or not in a Texas whole county HPSA category. While the overall classification suggests that the independent variables accurately predicted the likelihood of practicing in a Texas Whole County HPSA, the model was constructed to predict no members in the "yes" category.

Table 4.38. *Texas Whole County HPSA, Classification Table*

	Observed		Predicted		
			HPSA		Percentage Correct
			No	Yes	.00
Step 1	Whole Count Texas HPSA status	No	2,483	0	100.0
		Yes	170	0	.0
	Overall Percentage				93.6

a The cut value is .500

Table 4.39 shows the third set of results produced by the analysis, the summary of model variables.

Table 4.39. *Texas Whole County HPSA, Variables in the Equation*

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% Confidence Interval.for EXP(B)	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Step 1(a)	Medical School Location			30.445	2	.000			
	Medical School Location, Texas	-1.018	.205	24.586	1	.000	.361	.242	.540
	Medical School Location, IMG	-1.417	.317	19.955	1	.000	.242	.130	.451
	Degree (DO)	-.393	.287	1.875	1	.171	.675	.385	1.185
	Residency Type			10.864	3	.012			
	Residency Type, Family Practice	-.059	.237	.062	1	.804	.943	.592	1.501
	Residency Type, Internal Medicine	-.758	.269	7.942	1	.005	.469	.277	.794
	Residency Type, Pediatric	-.119	.352	.114	1	.736	.888	.445	1.771
	Residency in a Medical School (No)	.684	.180	14.398	1	.000	**1.982**	1.392	2.823
	Gender (Male)	.779	.190	16.812	1	.000	**2.178**	1.501	3.160
	Ethnicity			66.330	3	.000			
	Ethnicity (White)	-.120	.257	.217	1	.642	.887	.536	1.468
	Ethnicity (Black)	.237	.424	.313	1	.576	**1.268**	.552	2.911
	Ethnicity (Hispanic)	1.347	.240	31.384	1	.000	**3.845**	2.400	6.159
	Constant	-2.446	.416	34.569	1	.000	.087		

a Variable(s) entered on step 1: Medical School Location, Degree, Residency Type, Residency Located in a Medical School, Gender, and Ethnicity

While the binary logistic regression model did not predict group membership well, the strength of some variables showed that a residency program located away from a medical school is likely to produce physicians who will practice in Texas whole county HPSAs. The model also shows that Hispanic physicians were more almost four times more likely to locate in such an area. Interestingly, gender was a strong predictor, with twice as many men predicted to locate in these areas as women.

Summary

Frequency distributions, Chi-Square tests, and binary logistic regression analyses were used to evaluate Texas primary care residency programs and the likelihood that the physicians who complete them would remain in Texas to practice, and secondarily, whether they would practice in a Texas whole county HPSA. The Chi-Square tests identified the independent variables that had statistically significant relationships with the dependent variables. Residency type, medical school of graduation, type of degree, residency program location, gender, and ethnicity were further analyzed using binary logistic regression analysis to determine whether practicing in Texas and practicing in a whole county HPSA could be predicted. Chapter 5 will present a discussion of the findings, conclusions, provide recommendations for policy development, report limitations of this study, and present suggestions for future research.

CHAPTER 5

Discussion

This study focused on understanding physician practice patterns based on the behaviors of 4,250 Texas primary care residents. Texas was selected as the site for this study because of access to data and the researcher's prior knowledge of its primary care residency programs. During the data collection period, 1996 through 2001, Texas' general population experienced record growth; however, Texas medical school enrollments and graduation rates were flat. Enrollment in the state's primary care residency programs grew during the first three years of the study period (1996 through 1999) and then declined in the last two years (Table 1. *Primary Care Completions by Year*, p.102).

Two family practice residency programs were established during the study period, Brazos Valley located in Bryan (1996) and Santa Rosa located in San Antonio (1997). Data from these programs showed that they trained physicians who remained and practiced in the state. Two obstetrics/gynecology residency programs, Tri-City and University of North Texas Health Science Center, both located in Fort Worth, were closed during the study period.

Research Questions and Hypotheses

This dissertation analyzes one state's efforts to increase the number of its primary care physicians and encourage their retention and distribution to rural underserved areas. This analysis was accomplished through an examination of physicians as they completed training in Texas family medicine, internal medicine, pediatrics, and obstetrics/gynecology residency programs. The primary purpose of this study was to increase understanding and document similarities and differences in the primary care residency programs' production of physicians who remained in Texas and who practiced in a whole county HPSA following training. Research questions and hypotheses were developed to address the primary purpose based on knowledge and understanding of residency programs and practice locations as reflected in the literature. The following analyses were used to evaluate the research questions and hypotheses: frequency distributions, geographic depictions, Chi-Square tests and binary logistic regression. These analyses provided supporting evidence that significant differences exist among resident programs in the four primary care medical specialties. Differences were also found in residents' likelihood to remain in Texas to practice and their likelihood to practice in whole county HPSAs.

Research Questions and Findings

Which primary care residency programs produce the greatest proportion of physicians that practice in Texas?

Seventy-three of the 77 residency programs in the study had 50 percent or more of their residents identified as practicing in Texas. This finding suggests that all four primary care specialties educate and train physicians who remain and practice in the state. Of the top producing programs, 15 had more than 75 percent of their residents identified as actively practicing in Texas. Notably, 14 of those were family practice programs and one was an internal medicine program. With 82 percent of their residents identified as practicing in Texas, both Corpus Christi Memorial and Parkland Memorial Family Practice Residency Programs were identified as the most successful programs in retaining physicians in the state.

In Chapter 4, Tables 4.12 through 4.15, the in-Texas retention for each of the residency programs was presented by medical specialty. These tables show the number of residents who completed training during the study period and the percentage trained who were identified as actively practicing in Texas as of March 2005. More than 70 percent of the residents trained in family practice residency programs remained in Texas at the time of the analysis, while only about 60 percent of the residents in the other three specialties remained. Additionally, the Chi-Square test showed this difference to be statistically significant with a p-value less than .05. Further supporting evidence was provided in the results of the logistic regression analysis, which included medical specialty as a significant predictor variable in remaining in Texas.

What characteristics [of programs that produced physicians who stayed in Texas] do these programs share (e.g., residency program type, location, sponsorship)?

In reviewing the residency programs with the greatest retention in Texas, similarities were noted. As described previously, family practice programs were the top producers of residents who remained in Texas. With 14 of the top 15 programs, family practice residency programs clearly provided physicians who remain in Texas following residency training during the study period. Of the 744 family practice residents in the study, 70 percent were identified as practicing in Texas in March 2005. A majority of the top producing family medicine residency programs (9 of 14) were established in the 1970s and many were located in areas of general population growth, including Austin, Dallas/Fort Worth, and San Antonio. Interestingly, ten of the top 14 producing family practice residency programs were not physically located in a medical school. Residency program location was found to be significantly related to practice location, but in an interesting way; those programs located within a medical school setting produced a greater percentage of physicians who left the state following residency training. Additional supporting evidence for this was provided in the results of the logistic regression analysis, where residency program location was a contributor in the predictive model for in-Texas retention.

The location of a residency program within a medical school may attract a resident more interested in cutting edge research and acquisition of technical skills related to innovative surgical procedures. As a result, such programs may have residents who are more likely to continue their training following their initial residency experience. Such additional training may be offered in other states and require physicians to leave Texas. Conversely, physicians who complete their training in smaller community hospitals may feel well-qualified to begin their careers following completion of residency training. Or, they may not have the option to continue their training following their initial residency experience as such advanced post-graduate positions are highly competitive.

How do various personal characteristics, such as where residents completed their undergraduate and medical education, correlate with practice location in Texas?

Location of medical education was found to be significantly related to practice in Texas. More than 76 percent of primary care residents who graduated from Texas medical schools remained in Texas to practice, while only 52 percent of the IMGs and 44 percent of the non-Texas/U.S. graduates did so. The binary logistical regression analysis provided further support for this variable as a predictive measure for in-Texas retention. The logistic regression analysis showed that Texas medical school graduates were almost three times as likely to remain in Texas following residency training, as compared with graduates from other U.S. or foreign medical schools. Limited data were available to connect undergraduate location (a Texas public college or university) to residency training and practice location; however limited available data made this analysis questionable. Further research related to college graduation and practice location would better describe the current education pipeline.

What influence do gender and ethnicity have on practice location?

The individual demographic information on gender and ethnicity showed differences as related to in-Texas retention. With 13 percent more men than women in the study population, women primary care residents had not achieved parity in primary care residency programs at the time of the study. This is likely to change as the number of women and men enrolled in medical schools equalizes. This study found that male residents were significantly more likely to remain in Texas to practice than were female residents. Even so, the differences in the percentages (65% men, 61% women) were not that large. Given the reality that women are enrolling in medical school in increasing numbers, this finding may change in the future. Continued monitoring of the gender differences and practice patterns is warranted. Additionally, the binary logistic regression analysis also showed that males were more likely than females to remain in Texas.

The study also found statistically significant differences among the residents when categorized by ethic groups: White, Black, Hispanic, and Asian,. Seventy-two percent of Hispanic residents remained, 66 percent of Black residents remained, 63 percent of White residents remained, and 57 percent of Asian residents remained. (With only 4 residents identified as Native Indian/Pacific Islander, the number was too small to include in the analyses). In the binary logistic regression analysis, ethnicity was found to be predictive of remaining in Texas to practice. Blacks and Hispanics were shown to be more likely to remain in Texas than were Whites or Asians.

Which primary care residency programs produce the greatest proportion of physicians that practice in rural and underserved areas in Texas, as defined as primary care whole-county HPSAs?

Eleven of the 77 residency programs had more than ten percent of their residents identified as practicing in a Texas whole county HPSA. The McAllen Family Practice Residency Program with 55 percent produced the highest percentage of these residents. However, this finding is misleading. The McAllen Family Practice Residency Program is located in Hidalgo County, which at the time of the study was a designated as a whole county HPSA. This changed in 2007, when Hidalgo and adjacent Cameron counties were removed from the list. Additionally, with a combined population of one million, these two counties cannot be considered rural. However, both counties are considered underserved, and have for many decades had low numbers of physicians available to provide health care services to the population. Hidalgo and Cameron counties also have a high proportion of population who do not have health insurance. Both counties have experienced prolonged population increases and are unique in their geographic proximity to Mexico. These two counties are unlike most of the other whole county HPSAs, which are sparsely populated. So, while the success of the McAllen Family Practice Residency Program may not reflect a tendency of its residents to locate in rural communities, it has been successful in retaining physicians that serve its local community, which is medically underserved.

Included among the top producing residency programs were pediatric and obstetric/gynecology programs, as well as family practice residency programs. No internal medicine residency program produced ten percent or more residents who were practicing in a whole county HPSA. In fact, in the most successful internal medicine residency programs only six percent of the completers practiced in a whole county HPSA

What characteristics do these programs share?

The residency programs that produced ten percent or more residents identified as locating in a whole county HPSA were located in more remote areas of the state, including Amarillo, Odessa, and Tyler. Only one program that had 10 percent of its residents identified as practicing in a whole county HPSA was located in a medical school (TTUHSC Lubbock). Programs with greater percentages of residents locating in whole county HPSAs may be less competitive to enter. However, these programs may offer their residents greater opportunities to experience a broad array of medical cases, given that a majority of these successful programs served as the only residency program in the hospital in which they were housed. This was the case for seven of the top 11 programs. So, location of the residency away from a medical school and in a hospital with few or no other residency programs were characteristics shared by many of the most successful programs that produced physicians identified as practicing in whole county HPSAs.

Which residents are more likely to practice in a Texas primary care whole-county HPSA?

Male residents, at eight percent, were twice as likely as female residents, at four percent, to practice in a whole county HPSA. Additionally, residents differed depending on the type of residency program they completed. Family practice and pediatric residency programs produced physicians who practiced in whole county HPSAs in greater numbers than the other primary care residency programs. Internal medicine residency programs produced the smallest proportion of residents actively practicing in whole county HPSAs. Additionally, where a physician graduated from medical school played a role in whether the physician located in a whole county HPSA. International

Medical Graduates (IMGs) were three times as likely to locate in a whole county HPSA, as compared with Texas medical school graduates, and almost five times as likely as graduates from medical schools in other states. Finally, ethnic differences were noted. Hispanic residents were significantly more likely to practice in a whole county HPSA. However, this finding may be more reflective of the inclusion of Hidalgo and Cameron counties as whole county HPSAs. The binary logistic regression analysis showed that Hispanic residents were three times as likely to practice in a whole county HPSA, and men were twice as likely as women to practice in these areas.

Finally, is there a difference among the various primary care specialties in terms of where residents practice?

Statistically significant differences were noted among the medical specialties of the residents identified as practicing in whole county HPSAs. While only 6.4 percent of all residents were found to practice in HPSAs, 8.6 percent of the Family Practice residents and 7.7 per cent of Pediatric residents located in these less populated counties. On the other hand, just 3.7 percent of Obstetrics/Gynecology residents and 4.7 per cent of Internal Medicine residents did so.

Hypotheses and Results

The proposed hypotheses were presented in Chapter 1, and the findings presented in Chapter 4 provide support for many of them. These findings are discussed in the following section.

Related to staying and practicing in Texas following residency training:

● *The percentage of physicians retained in Texas varies by primary care residency specialty.*

With just over 70 percent of the family physicians who completed residency training in Texas during the study period identified as practicing medicine in Texas, family practice residency programs differed significantly from the other medical specialties in their in-Texas retention. The hypothesis that the percentage of physicians retained in Texas varies by primary care medical specialty is supported by this study.

● *Resident physicians trained in large metropolitan areas are more likely to practice in large metropolitan areas.*

The study data showed that physicians who trained in large metropolitan areas were more likely to leave Texas. This finding is somewhat misleading, since the majority of obstetrics/gynecology, internal medicine and pediatrics residency programs are located in large metropolitan areas of the state and family practice residency programs are distributed throughout the state. This comparison is not as useful as it could be, as it shows that family residents tend to stay in Texas to practice, while residents in other specialties do not. This hypothesis is neither confirmed, nor refuted by this study.

● *Resident physicians who graduate from Texas medical schools have a greater likelihood of practicing in state.*

Fifty-two percent of the study population graduated from Texas medical schools. Of those, 77 percent were identified as actively practicing in Texas in March 2005. The binary logistic regression model showed that the independent variable most associated with practicing in Texas was graduating from a Texas medical school. In fact, primary care physicians who graduated from a Texas medical school were almost three times as likely to remain in Texas to practice. This hypothesis is supported by this study.

● *Gender influences whether primary care physicians practice in Texas.*

Women residents differed from men in their in-state retention. Women in this study remained in Texas just under 61 percent of the time, while men remained at just under 65 percent of the time. While this difference was significant in this study, because the gender balance in residency training programs is changing with more women entering medicine, continued monitoring of this difference is warranted. This hypothesis was supported by the study findings.

● *International medical graduates (IMGs) are more likely to stay in Texas after completing their residency programs.*

International medical graduates (IMGs) were more likely to remain in Texas following their residency training than were residents who had graduated from other U.S. medical schools outside of Texas. However, they were less likely to remain than were

Texas medical school graduates. A closer look at the IMG population showed that half reported U.S. citizenship status, 37 percent reported they were non-U.S. citizens, and the remaining 13 percent did not report any citizenship status. This finding suggests that close to 40 percent of IMGs would be required to address immigration issues in order to remain in Texas to practice. Many of these residents would likely be required to leave the country for a time before being allowed to obtain a state medical license. The largest number of IMGs in this study, at just over 10 percent, graduated from medical programs located in Mexico. The next largest number graduated from medical schools located in Pakistan. While the findings related to IMGs were informative, the hypothesis was not confirmed. Instead, it was clear that Texas medical school graduates were the most likely to remain in-state.

Related to practicing in rural Texas (whole county HPSA):

● *Primary care residency programs located in rural populated areas of the state produce primary care physicians that remain in similarly populated areas.*

Only two residency programs, the Harlingen and McAllen Family Practice Residency Programs were located in designated whole county HPSAs at the time of the study. While these two counties have for a long period been medically underserved, with a combined population of more than one million residents, they cannot be considered rural. The residency programs located in these two counties were successful in producing physicians identified as practicing in whole county HPSAs. Additionally, programs located in Amarillo, Corpus Christi, Odessa, and Tyler were identified as successful in having residents locate in whole county HPSAs. These programs were not located in whole county HPSAs, nor could they be considered located in rural communities. Therefore, this hypothesis was not supported by this study.

- *Family physicians are more likely to practice in smaller, rural communities than are other primary care physicians.*

Family physicians were more likely to practice in a whole county HPSA than were the residents of the other specialties. Six of the top 11 residency programs that produced physicians who practiced in whole county HPSAs were family practice programs. Although the total number of residents identified as practicing in a whole county HPSA was low (n=172), and represented just over 6 percent of the residents who remained in Texas, the top 11 programs were responsible for training 44 percent of the residents identified as practicing in HPSAs. .

Notable variations were identified by medical specialty. Family practice pediatric programs) produced greater numbers of residents who located in whole county HPSAs. Residents in these specialties were significantly more likely to practice in HPSA's. Therefore, support for this hypothesis was confirmed.

- *Women and under-represented resident physicians are less likely to practice in rural Texas.*

Differences were noted for both gender and ethnic groups as they related to practicing in a whole county HPSA. Women, at 4 percent, were significantly less likely than men, at 8 percent, to locate in whole county HPSAs. Additionally, Hispanic residents (at 18.2%) were significantly more likely to practice in a whole county HPSA than were Asians (5.2%), Blacks (5.1%), or Whites (3.7%). Binary logistic regression analysis supported this and included gender and ethnicity were important predictor variables. Partial support for this hypothesis was found as women and Blacks were found to be less likely to locate in these areas. However, Hispanic residents were significantly more likely to practice in a whole county HPSA, so part of the hypothesis was not confirmed.

- *International medical graduates are more likely to practice in rural Texas.*

Statistically significant differences were noted in residents identified as practicing in a whole county HPSA depending on where they completed medical school. International Medical Graduates (IMGs) were significantly more likely to practice in a whole county HPSA than were Texas medical school graduates or graduates from medical school outside of Texas. In fact IMGs (at 15.2%) were about three times as likely to locate in such areas, as compared with Texas medical school graduates (at 5.2%), and almost five times as likely as graduates from non-Texas/US medical schools (at 3.2%). This study supported this hypothesis.

Conclusions

Understanding the role of residency training in the supply of a state's physician workforce is essential to estimate the adequacy of the supply, to conduct planning, and to develop policies to influence future physician production (education/training) and distribution. The health of a state's population depends on the ability to access health care services in a timely and regular manner. Ensuring that the state has enough of the right kinds of physicians to care for its population is an appropriate role for state policy planners. Often such planning is based on long-held beliefs voiced by professional organizations with an interest in the outcome rather than a critical assessment of empirical data. For example, there is a persistent belief that all resident physicians remain in the state in which they train. This study suggests that that belief has some limits, as statistically significant differences in in-Texas retention were found among primary care medical specialties. Notably, physicians differed in where they located depending on where they graduated from medical school, what kind of medical specialty they chose, and where their residency programs were located. This study provides support for the position that residents who receive their medical school degree in Texas are more likely to remain in the state to practice. The study data also show there are differences in primary care resident physicians' retention in Texas and their distribution to underserved areas. However, based on the data analysis, predictive models for physician retention and distribution to whole county HPSAs are of limited, yet notable value.

In reviewing the binary logistical regression analyses, several points are worth noting. The binary logistic regression suggested that the models developed to predict in-Texas retention and practicing in whole county HPSAs had some, but limited, predictive value. The independent variables were linked to practice in Texas and practice in HPSA.

Notably, about 15 percent of the variance in residents' decisions to remain in Texas to practice could be predicted by the characteristics of the residency program and the residents' demographic variables. The binary logistic regression analysis was a bit stronger for whole county HPSA. About 17 percent of the variance in decisions to practice in these areas could be predicted by the independent variables. However, the predictive model itself was questionable, since the population explored was so heavily weighed toward not practicing in a whole county HPSA.

Even though variables as basic as where one attended medical school and residency training program location were shown to have only limited predictive value, this study has implications for policy development. The following recommendations are based on the study findings and conclusions.

Recommendations

These recommendations are made in an effort to help develop state policies which are based on empirical findings, and which are designed to promote the training of physicians likely to remain in Texas and optimize training that encourages distribution of physicians to whole county HPSAs.

1. <u>Primary care residency programs that have a documented history in training physicians who remain in Texas should receive additional state funding under an enhancement to the graduate medical education formula</u>. In 2005 the State of Texas initiated formula funding for all residency programs aligned with Texas

medical schools. This funding was expanded by the 80th Texas Legislature in 2007, and provided $5,000 per resident to each of the public health-related institutions and to independent Baylor College of Medicine. The Legislature should maintain formula funding, with the provision that any additional new dollars provided for graduate medical education be appropriated based on success of a program in retaining physicians in Texas and distributing physicians to whole county HPSAs. Further additional support could be provided based on success of programs to retain these physicians at 5-years and 10-years after the completion of residency training. Independent residency programs should also receive a comparable funding mechanism as is currently the case with funds trusteed to the Coordinating Board.

2. Existing loan repayment programs should be enhanced and physicians who receive support under the Physician Education Loan Repayment Program should serve as mentors to encourage a new generation of physicians to locate in whole county HPSAs. Residency programs identified in this study as successful in having residents locate in HPSAs should receive support for this, through state grants or additional formula incentives. Development of such a mentoring program could be a cooperative effort between the Coordinating Board, the Office of Rural and Community Affairs, and the Department of State Health Services Bureau of Primary Care.

3. Internal medicine residency programs in Texas should be studied to better understand practice patterns and their importance to the state. Because internal medicine residents were less likely to remain in Texas and least likely to locate in a Texas whole county HPSA, it would benefit the state to better understand what role internal medicine has in the state's health care workforce.
4. Texas health-related institutions should establish statewide targets for each medical specialty area and report the retention of their residents in all specialty areas to the Legislative Budget Board and interested legislators.

Implementation of these recommendations would not introduce significant new costs. However, the state should recognize the costs of adding new and expanded monitoring efforts and resources should be provided to support such efforts.

Study Limitations

Several limitations were encountered in this study. These included the length of time required for data collection, the demographic nature of the data, the focus on primary care, and the lack of information about residents who left the state without obtaining a Texas medical license. First, the data collection effort required several years to complete. Data were obtained from each primary care residency program on an annual basis over a six-year period. Gathering data over this length of time has inherent limitations, including changes within residency program personnel. This resulted in required re-training on survey procedures. Also, in an effort to describe best where physicians practice, the study required the passage of an adequate amount of time before documenting resident practice locations. However, the study data were matched as of one particular date (March 15, 2005). Thus, data obtained in 1996 reflected physicians who were in practice far longer than were the physicians who completed their residency training in 2001. There was a ten year passage of time between the completion of the first residents included in the study and the match data in 2005, but only four years had passed when the last group of residents were matched. If data were collected over a longer period of time and matched at intervals for each of the groups, different patterns of practice might be evident.

Some data were incomplete or their availability was limited. Data on bachelor's degrees were not available for primary care residents who graduated prior to 1998. Additionally, these data were only available for those physicians who had graduated from Texas public institutions of higher education. Baccalaureate degree data were not available for residents who graduated from Texas private institutions or from out-of-state institutions. An additional limiting factor was the level of detail related to international medical graduates. Little to no information was available for academic achievement. A greater understanding of the educational histories of these physicians, and the length of their residence in Texas, would provide greater insight into practice patterns.

This study focused exclusively on primary care specialties. The four medical specialties-- family practice, internal medicine, pediatrics, and obstetric/gynecology-- were described and analyzed. While these specialty areas include the broadest definition of primary care, designations are not precise, nor do they necessarily reflect the area in which a physician actually practices. Physicians trained in other specialty areas, such as general surgery, may also serve their patient population as primary care physicians. This is often the case in smaller communities. For example, there is a general surgeon located in Palestine, Texas who serves his patient population as a primary care provider, in addition to his role as a general surgeon. This study was not able to assess this reality. The primary care medical specialties included in this study represent the major entry points into graduate medical education. However, the national accrediting body, the Accreditation Council for Graduate Medical Education, lists more than 26 medical specialty areas. It was not possible to include all of these specialty areas in this study.

There was a lack of information available for the physician residents who did not obtain a Texas medical license. For physicians who did not obtain a Texas medical license following completion of their Texas residency training, it was not possible to determine where they were or what type of medical practice they were pursuing, if any. While the reasons for not obtaining a Texas medical license are as varied as the individuals themselves, it is likely these particular residents may be grouped into some general categories including: 1) deciding not to practice medicine; 2) pursuing additional specialty training outside Texas; and 3) deciding to locate outside Texas, temporarily or permanently. Of note, it may be that some of the physicians who did not obtain a Texas medical license may be practicing in underserved areas in other states.

In addition to the limitations described, the demographic variables included in this study were of limited predictive value. Only demographic variables were used in the analyses. Many other factors influence practice location decisions including personality, location affinity, familial responsibilities and needs, availability of practice opportunity and reimbursement levels for various medical specialties. Measures of these variables were unavailable for this study.

Future Exploration

It is essential that the role of residency training and physician practice continue to be monitored and evaluated; therefore, future exploration of graduate medical education is critical. Recent developments by the Texas Legislature, including increased appropriations for residency training suggest that the issue of graduate medical education will continue to hold the interest of state policy makers for many years. National calls for increases in medical school enrollments have resulted in increases in Texas medical school enrollments, and this will result in the need to establish new and/or expand existing residency programs. Additionally, a newly implemented data collection mechanism, the Coordinating Board Management-00 Resident (CBM-00R) is now in place at the Coordinating Board. This mechanism will provide general information about all residents training in Texas, and will serve as the foundation for future exploration of graduate medical education. These future studies should include all medical specialties, not just the four primary care specialties included in this study.

Many factors influence practice location decisions, including those mentioned in the last section. Future studies should include them and others that may be identified as being relevant in the future. Data that identify where physicians grow up, as defined by high school graduation, and measures of academic achievement may provide greater insights into physician practice patterns.

Further exploration of practice intent should be carried out. This would provide greater understanding of the intentions of entering medical students and would provide insights into medical specialty areas. Although collection of this kind of data would be difficult to standardize, understanding physician practice intentions would expand the understanding of the future physician workforce and provide greater depth to policy discussions.

Finally, because the Texas population is experiencing rapid increases of its older and younger age groups, studies of how these different populations use health care providers may provide policy makers with greater insights into the changing needs of the state. How the future Texas population will be affected by the availability and accessibility of primary care physicians should be documented and the information gathered should be used to conduct studies that analyze how these demographic changes affect the physician workforce.

Summary

Residency training is an essential piece in supplying the Texas physician workforce and ensuring that its stability and long-term growth will position it to care for the population. This study explored the relationship between residency training and practice location on a statewide basis for the four medical specialties within primary care. Residents who completed training in family practice, internal medicine, obstetrics/gynecology, and pediatric residency programs and remained in Texas were identified through a cooperative data sharing effort between the Texas Higher Education Coordinating Board and the Texas Medical Board.

The resulting information documented in this dissertation has hopefully increased the understanding concerning the importance of primary care residency training in the Texas physician workforce. Data showed that those residents who trained in Texas largely remained in Texas and actively practiced medicine years after their residency training had been completed. The training and location of primary care physicians in Texas is influenced by what medical specialty programs are available and where. This suggests that increasing the number and type of residency programs in more remote areas may have a positive influence on the physician workforce of those regions. This study confirms the finding of other institutional and single medical specialty studies that physicians tend to remain in the state in which they complete their residency training. However, this study found that there are variations by primary care specialty, gender, ethnicity, and program location. While this study focused on Texas along, there is little reason to believe that Texas primary care residents behave differently from primary care residents in other states.

Appendix A

Texas Medical Schools		
Medical School	Established	Degree Awarded
University of Texas Medical Branch at Galveston, Medical School	1881	MD
Baylor College of Medicine	1900	MD
University of Texas Southwestern Medical Center at Dallas, School of Medicine	1943	MD
University of Texas Health Science Center at San Antonio, School of Medicine	1959	MD
University of Texas Health Science Center at Houston, Medical School	1969	MD
Texas Tech University Health Sciences Center, School of Medicine	1969	MD
University of North Texas Health Science Center at Fort Worth, Texas College of Osteopathic Medicine	1970	DO
Texas A&M University System Health Science Center, School of Medicine	1977	MD

Appendix B

Texas Higher Education Coordinating Board
PRIMARY CARE TRACKING SYSTEM – ANNUAL SURVEY OF RESIDENTS

Program Name:_________________________________ Coordinating Board Number:_______________________

Person Completing Survey ____

Telephone Number _______________________________E-mail Address___________________________________

RESIDENTS IN TRAINING | **Post Graduate Year (PGY)-1** | **TOTAL (Include IMGs)**

1. Number of Accreditation Council of Graduate Medical Education (ACGME) or American Osteopathic Association (AOA) approved positions \Include International Medical Graduates (IMGs) ________ ________

2. Number of residents in training on September 1, 2000: PGY-1_____ PGY-2_____ PGY-3_____ PGY-4____

RESIDENTS SATISFACTORILY COMPLETING TRAINING | **IMGs (include IMGs)** | **TOTAL**

3. Number of residents satisfactorily completing the residency program in Academic Year 2000-2001 ________ ________

RESIDENTS LEAVING WITHOUT COMPLETING THE PROGRAM | **IMGs (include IMGs)** | **TOTAL**

4. Total number of residents leaving without completing the program _________ _________

5. USMG residents leaving without completing the program: PGY-1____ PGY-2_____ PGY-3____ PGY-4_____

6. IMG residents leaving without completing the program: PGY-1____ PGY-2_____ PGY-3____ PGY-4_____

Of those residents who left without completing the program, how many: | **IMGs (include IMGs)** | **TOTAL**

7. Left to enter another residency program ___________ ___________

8. Left following conclusion of a transitional year ___________ ___________

9. Left to go to a fellowship program ___________ ___________

10. PGY levels of residents entering other residency program: PGY-1____ PGY-2_____ PGY-3____ PGY-4_____

11. If resident(s) entered another residency program, provide name, location, and specialty of program:

____

	IMGs (include IMGs)	**TOTAL**
12. Left to enter practice	___________	___________
13. Left to enter military service	___________	___________
14. Left to enter Public Health Service/National Health Service Corps	___________	___________
15. Left medicine	___________	___________

16. Left for other reason, please explain:____

Texas Higher Education Coordinating Board Primary Care Tracking Survey
Resident Completion Information Sheet

Residency Program Name/Location: ____

CB Program Number: _____________________ ***Person Completing Survey:***__________________________

*Telephone Number:*_(__)____________________ *E-mail address*:___________________________________

NAME OF RESIDENT WHO SATISFACTORILY COMPLETED RESIDENCY

TRAINING:____
Last First Middle Name or Initial

Date of Birth: __________/__________/__________ SSN: _____________-______________-____________

GENDER:
[ ] 1. Male
[ ] 2. Female

CITIZENSHIP:
[ ] 1. US citizen or resident alien
[ ] 2. Non-resident alien

ETHNICITY:
[ ] 1. White, non-Hispanic
[ ] 2. Black, non-Hispanic
[ ] 3. Hispanic
[ ] 4. Asian or Pacific Islander
[ ] 5. American Indian or Alaskan Native

Please use the definitions in the box below to complete the ethnicity information, Excerpt from EEOC Form 164, State and Local Government Information

White (not Hispanic origin):	All persons having origins in any of the original peoples of Europe, North Africa, or the Middle East.
Black (not Hispanic origin):	All persons having origins in any of the Black racial groups of Africa.
Hispanic:	All persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.
Asian or Pacific Islander:	All persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands. This area includes the Philippine Islands, China, Japan, Korea and Samoa.
American Indian or Alaskan Native:	All persons having origin in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition

MEDICAL SCHOOL OF GRADUATION:(month/year)____
SchoolName/Location____
Degree: [ ] M.D. [ ] D.O. Texas Medical License or Institutional Permit Number:__________________
Activity After Completion of Residency Training:

Practice Setting (check one):
0 [ ] Did not answer
1 [ ] Military
2 [ ] VA or PHS
3 [ ] Intern, Resident, Fellow
4 [ ] Hospital Based
5 [ ] Solo
6 [ ] Partnership/Group
7 [ ] Other, please specify: __________

Practice Activity (check one):
0 [ ] Did not answer
1 [ ] Direct Patient Care
2 [ ] Medical Teaching
3 [ ] Administration
4 [ ] Research
5 [ ] Not in Practice
6 [ ] Other, please specify:__________

Practice Mailing Address: (please identify the intended city of practice, if known, even if address is not yet known.)

Street Address, Box, etc.

City State Zip Code

Appendix C.

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
1	Anderson	NO	Not Applicable	0
2	Andrews	NO	Not Applicable	0
3	Angelina	NO	Not Applicable	0
4	Aransas	YES	12/28/04	22,264
5	Archer	YES	8/2/2002	8,836
6	Armstrong	YES	6/14/2002	2,148
7	Atascosa	YES	7/24/2002	38,435
8	Austin	YES	99	23,566
9	Bailey	NO	Not Applicable	0
10	Bandera	YES	8/12/2003	18,701
11	Bastrop	YES	8/19/2002	56,809
12	Baylor	NO	Not Applicable	0
13	Bee	YES	7/24/2002	30,417
14	Bell	NO	Not Applicable	0
15	Bexar	NO	Not Applicable	0
16	Blanco	YES	3/15/2002	8,410
17	Borden	YES	5/25/2001	729
18	Bosque	NO	Not Applicable	0
19	Bowie	NO	Not Applicable	0
20	Brazoria	NO	Not Applicable	0
21	Brazos	NO	Not Applicable	0
22	Brewster	NO	Not Applicable	0
23	Briscoe	YES	11/10/04	1,790
24	Brooks	YES	6/28/2002	7,976
25	Brown	NO	Not Applicable	0
26	Burleson	YES	6/28/2002	16,470
27	Burnet	NO	Not Applicable	0
28	Caldwell	YES	7/24/2002	32,065
29	Calhoun	NO	Not Applicable	0
30	Callahan	NO	Not Applicable	0
31	Cameron	Proposed for Withdrawal*	2/11/2004	332,545
32	Camp	NO	Not Applicable	0
33	Carson	YES	6/14/2002	6,509
34	Cass	NO	Not Applicable	0
35	Castro	Proposed for Withdrawal*, 3/10/05	6/8/2001	8,277
36	Chambers	YES	8/2/2002	25,979
37	Cherokee	NO	Not Applicable	0

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
38	Childress	NO	Not Applicable	0
39	Clay	NO	Not Applicable	0
40	Cochran	YES	8/2/2002	3,723
41	Coke	YES	6/26/2002	3,864
42	Coleman	YES	7/30/2002	9,226
43	Collin	NO	Not Applicable	0
44	Collingsworth	YES	6/28/2002	3,196
45	Colorado	NO	Not Applicable	0
46	Comal	NO	Not Applicable	0
47	Comanche	NO	Not Applicable	0
48	Concho	Proposed for Withdrawal*, 3/10/05	9/28/01	3,569
49	Cooke	NO	Not Applicable	0
50	Coryell	YES	12/21/2004	60,132
51	Cottle	NO	Not Applicable	0
52	Crane	YES	6/6/2002	3,984
53	Crockett	YES	3/2/2001	4,083
54	Crosby	YES	9/26/03	7,245
55	Culberson	YES	3/2/2001	2,969
56	Dallam	NO	Not Applicable	0
57	Dallas	NO	Not Applicable	0
58	Dawson	YES	10/17/2002	14,700
59	Deaf Smith	YES	4/11/2003	18,505
60	Delta	YES	6/14/2002	5,316
61	Denton	NO	Not Applicable	0
62	De Witt	NO	Not Applicable	0
63	Dickens	YES	6/14/2002	2,759
64	Dimmit	NO	Not Applicable	0
65	Donley	YES	6/11/2002	3,671
66	Duval	YES	8/2/2002	13,002
67	Eastland	Proposed for Withdrawal*, 3/10/05	1/23/01	17,748
68	Ector	NO	Not Applicable	0
69	Edwards	NO	Not Applicable	0
70	Ellis	NO	Not Applicable	0
71	El Paso	NO	Not Applicable	0
72	Erath	NO	Not Applicable	0
73	Falls	YES	7/18/2002	17,350
74	Fannin	YES	12/19/2003	31,763
75	Fayette	NO	Not Applicable	0
76	Fisher	YES	8/2/2002	4,344
77	Floyd	NO	Not Applicable	0

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
78	Foard	YES	6/14/2002	1,622
79	Fort Bend	NO	Not Applicable	0
80	Franklin	NO	Not Applicable	0
81	Freestone	NO	Not Applicable	0
82	Frio	YES	7/31/2002	15,407
83	Gaines	YES	7/23/2002	14,453
84	Galveston	NO	Not Applicable	0
85	Garza	NO	NA	0
86	Gillespie	NO	Not Applicable	0
87	Glasscock	YES	6/21/2002	1,406
88	Goliad	YES	6/28/2002	6,921
89	Gonzales	NO	Not Applicable	0
90	Gray	NO	Not Applicable	0
91	Grayson	NO	Not Applicable	0
92	Gregg	NO	Not Applicable	0
93	Grimes	Proposed for Withdrawal*	6/25/2002	20,820
94	Guadalupe	NO	Not Applicable	0
95	Hale	NO	Not Applicable	0
96	Hall	YES	6/21/2002	3,782
97	Hamilton	NO	Not Applicable	0
98	Hansford	YES	9/26/2003	5,443
99	Hardeman	NO	Not Applicable	0
100	Hardin	YES	12/19/2003	47,647
101	Harris	NO	Not Applicable	0
102	Harrison	NO	Not Applicable	0
103	Hartley	YES	1/19/2001	5,504
104	Haskell	NO	Not Applicable	0
105	Hays	NO	Not Applicable	0
106	Hemphill	NO	Not Applicable	0
107	Henderson	NO	Not Applicable	0
108	Hidalgo	YES	99	567,755
109	Hill	NO	Not Applicable	0
110	Hockley	Proposed for Withdrawal*, 5/20/03	98	22,330
111	Hood	NO	Not Applicable	0
112	Hopkins	NO	Not Applicable	0
113	Houston	NO	Not Applicable	0
114	Howard	NO	Not Applicable	0
115	Hudspeth	YES	6/14/2002	3,240
116	Hunt	NO	Not Applicable	0
117	Hutchinson	NO	Not Applicable	0

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
118	Irion	YES	8/7/2003	1,803
119	Jack	NO	Not Applicable	0
120	Jackson	YES	12/11/2003	14,664
121	Jasper	NO	Not Applicable	0
122	Jeff Davis	YES	9/10/2001	2,207
123	Jefferson	NO	Not Applicable	0
124	Jim Hogg	YES	2/26/02	5,281
125	Jim Wells	NO	Not Applicable	0
126	Johnson	YES	1/25/2001	125,289
127	Jones	YES	7/28/2003	20,820
128	Karnes	YES	8/2/2002	15,431
129	Kaufman	NO	Not Applicable	0
130	Kendall	NO	Not Applicable	0
131	Kenedy	YES	8/7/2003	410
132	Kent	YES	6/14/2002	859
133	Kerr	NO	Not Applicable	0
134	Kimble	YES	1/23/01	4,464
135	King	YES	6/14/2002	356
136	Kinney	YES	8/2/2002	3,359
137	Kleberg	NO	Not Applicable	0
138	Knox	NO	Not Applicable	0
139	Lamar	NO	Not Applicable	0
140	Lamb	YES	6/27/2002	14,694
141	Lampasas	Proposed for Withdrawal*	10/20/2003	18,402
142	La Salle	YES	12/8/2003	6,064
143	Lavaca	NO	Not Applicable	0
144	Lee	YES	6/28/2002	15,641
145	Leon	YES	8/2/2002	15,335
146	Liberty	YES	8/2/02	67,137
147	Limestone	NO	Not Applicable	0
148	Lipscomb	YES	8/7/2003	3,047
149	Live Oak	YES	8/2/2002	12,309
150	Llano	NO	Not Applicable	0
151	Loving	YES	6/14/2002	67
152	Lubbock	NO	Not Applicable	0
153	Lynn	YES	6/28/2002	6,537
154	McCulloch	NO	Not Applicable	0
155	McLennan	NO	Not Applicable	0
156	McMullen	YES	6/18/2002	851
157	Madison	YES	1/26/01	10,184
158	Marion	YES	8/2/2002	10,930

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
159	Martin	NO	Not Applicable	0
160	Mason	YES	8/2/2002	3,738
161	Matagorda	NO	Not Applicable	0
162	Maverick	Proposed for Withdrawal*, 10/16/02	98	47,202
163	Medina	YES	7/24/2002	38,636
164	Menard	YES	1/23/2001	2,360
165	Midland	NO	Not Applicable	0
166	Milam	YES	8/2/2002	24,214
167	Mills	YES	6/14/2002	5,151
168	Mitchell	YES	1/23/01	9,533
169	Montague	NO	Not Applicable	0
170	Montgomery	NO	Not Applicable	0
171	Moore	NO	Not Applicable	0
172	Morris	YES	8/7/2003	13,024
173	Motley	YES	6/21/2002	1,426
174	Nacogdoches	NO	Not Applicable	0
175	Navarro	NO	Not Applicable	0
176	Newton	NO	Not Applicable	0
177	Nolan	NO	Not Applicable	0
178	Nueces	NO	Not Applicable	0
179	Ochiltree	NO	Not Applicable	0
180	Oldham	YES	8/7/2003	2,236
181	Orange	NO	Not Applicable	0
182	Palo Pinto	NO	Not Applicable	0
183	Panola	YES	7/25/2002	22,597
184	Parker	NO	Not Applicable	0
185	Parmer	YES	6/28/2002	10,016
186	Pecos	NO	Not Applicable	0
187	Polk	YES	8/3/2002	40,927
188	Potter	NO	Not Applicable	0
189	Presidio	YES	7/28/2003	7,591
190	Rains	YES	6/28/2002	9,130
191	Randall	NO	Not Applicable	0
192	Reagan	NO	Not Applicable	0
193	Real	NO	Not Applicable	0
194	Red River	YES	6/27/2002	14,300
195	Reeves	YES	6/27/2002	12,612
196	Refugio	YES	6/11/2002	7,820
197	Roberts	YES	8/7/2003	894
198	Robertson	YES	7/18/2002	15,968
199	Rockwall	NO	Not Applicable	0

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
200	Runnels	YES	6/28/2002	11,472
201	Rusk	NO	Not Applicable	0
202	Sabine	YES	11/29/04	10,351
203	San Augustine	YES	10/27/2003	8,978
204	San Jacinto	YES	7/30/2002	22,224
205	San Patricio	YES	1/26/01	66,399
206	San Saba	YES	9/22/2003	6,206
207	Schleicher	YES	1/19/01	2,935
208	Scurry	NO	Not Applicable	0
209	Shackelford	YES	6/11/2002	3,299
210	Shelby	NO	Not Applicable	0
211	Sherman	YES	10/9/2003	3,273
212	Smith	NO	Not Applicable	0
213	Somervell	NO	Not Applicable	0
214	Starr	YES	8/2/2002	53,490
215	Stephens	YES	6/28/2002	9,606
216	Sterling	YES	8/7/2003	1,419
217	Stonewall	YES	8/2/02	1,690
218	Sutton	YES	10/31/2003	4,204
219	Swisher	YES	6/11/2002	8,277
220	Tarrant	NO	Not Applicable	0
221	Taylor	NO	Not Applicable	0
222	Terrell	YES	6/14/2002	1,081
223	Terry	NO	Not Applicable	0
224	Throckmorton	NO	Not Applicable	0
225	Titus	NO	Not Applicable	0
226	Tom Green	NO	Not Applicable	0
227	Travis	NO	Not Applicable	0
228	Trinity	YES	8/2/2002	13,765
229	Tyler	YES	9/12/2001	19,535
230	Upshur	YES	3/15/05	34,842
231	Upton	YES	8/28/02	3,401
232	Uvalde	NO	Not Applicable	0
233	Val Verde	Proposed for Withdrawal, 9/6/02	98	44,407
234	Van Zandt	YES	7/28/2003	49,664
235	Victoria	NO	Not Applicable	0
236	Walker	NO	Not Applicable	0
237	Waller	YES	8/2/2002	29,919
238	Ward	YES	10/21/2003	11,051
239	Washington	NO	Not Applicable	0

Texas
Primary Care
Whole County Health Professional Shortage Areas 2005

	County	Primary Care HPSA Designation?	Year Designated	Designated Population
240	Webb	Proposed for Withdrawal*	10/20/2003	211,430
241	Wharton	NO	Not Applicable	0
242	Wheeler	NO	Not Applicable	0
243	Wichita	NO	Not Applicable	0
244	Wilbarger	NO	Not Applicable	0
245	Willacy	Proposed for Withdrawal*, 9/11/02	98	20,062
246	Williamson	NO	Not Applicable	0
247	Wilson	YES	8/2/2002	32,376
248	Winkler	YES	12/8/2003	7,258
249	Wise	Proposed for Withdrawal*	10/17/2003	51,624
250	Wood	NO	Not Applicable	0
251	Yoakum	YES	12/29/2003	7,543
252	Young	NO	Not Applicable	0
253	Zapata	YES	6/28/2002	12,182
254	Zavala	YES	11/15/2004	11,237

*** These designations are proposed for withdrawal by the U.S. Department of Health and Human Services because they no longer meet the established primary medical care HPSA criteria. Any proposed withdrawal will not be effective until the date of the next publication of designated HPSAs in the FEDERAL REGISTER.**

Data Source: U.S. Department of Health and Human Services, Public Health Service, Health Resources and Services Administration (HRSA), Bureau of Primary Health Care, Shortage Designation Branch, 4350 East-West Highway, 9th Floor, Bethesda, MD 20814

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